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| | |
|--|---------|
| de Chambrier A. & Scholz T. - An emendation of the generic diagnosis of the monotypic <i>Glanitaenia</i> (Cestoda: Proteocephalidae), with notes on the geographical distribution of <i>G. osculata</i> , a parasite of invasive wels catfish | 1-9 |
| Bassi G. - Studies on Afrotropical Crambinae (Lepidoptera, Pyraloidea, Crambidae): Notes on the genus <i>Aurolalis</i> Błeszyński, 1970 | 11-20 |
| Hollier J. - The type specimens of Orthoptera (Insecta) species described by Ignacio Bolívar and deposited in the Muséum d'histoire naturelle de Genève | 21-33 |
| Pham V.A., Le T.D., Pham T.C., Nguyen L.H.S., Ziegler T. & Nguyen Q.T. - Two additional records of megophryid frogs, <i>Leptobrachium masatakasotoi</i> Matsui, 2013 and <i>Leptolalax minimus</i> (Taylor, 1962), for the herpetofauna of Vietnam | 35-43 |
| Eguchi K., Bui T.V., Oguri E. & Yamane S. - The first discovery of the “ <i>Pheidole quadricuspis</i> group” in the Indo-Chinese Peninsula (Insecta: Hymenoptera: Formicidae: Myrmicinae) | 45-55 |
| Breure A.S.H. - Annotated type catalogue of the Orthalicoidea (Mollusca, Gastropoda, Stylommatophora) in the Muséum d'histoire naturelle, Geneva | 57-103 |
| Lienhard C. & García Aldrete A.N. - An extraordinary new species of <i>Psyllipsocus</i> (Psocodea: ‘Psocoptera’: Psyllipsocidae) from the Biosphere Reserve Sierra de Huautla, Morelos, Mexico ... | 105-112 |
| Breure A.S.H. & Tardy E. - From the shadows of the past: Moricand senior and junior, two 19th century naturalists from Geneva, with their newly described taxa and molluscan types | 113-138 |
| Anisyutkin L.N. - New and little known Epilamprinae (Dictyoptera: Blaberidae) from the collections of the Muséum d'histoire naturelle de Genève and the Zoological Institute RAS, Saint Petersburg. Part 2 | 139-152 |
| Yin Z.-W. & Cuccodoro G. - <i>Colilodion schulzi</i> sp. n. (Coleoptera: Staphylinidae: Pselaphinae) from Palawan, the Philippines, with habitus photographs and a revised key to all <i>Colilodion</i> species | 153-158 |
| Löbl I. & Ogawa R. - Contribution to the knowledge of Himalayan and North Indian species of <i>Scaphidium</i> (Coleoptera, Staphylinidae) | 159-163 |
| Schuchert P., Sanamyan N. & Sanamyan K. - Observations on two large athecate hydroids (Cnidaria: Hydrozoa) from the Kamchatka Peninsula (NW Pacific) | 165-178 |
| Benjamin S.P. - Revision of <i>Cebrenninus</i> Simon, 1887 with description of one new genus and six new species (Araneae: Thomisidae) | 179-200 |
| Bialooki P. & Germann C. - <i>Ottiorhynchus (Choilisanus) theophrastus</i> sp. nov. from Lesbos Island, Greece (Coleoptera, Curculionidae, Entiminae) | 201-207 |

An emendation of the generic diagnosis of the monotypic *Glanitaenia* (Cestoda: Proteocephalidae), with notes on the geographical distribution of *G. osculata*, a parasite of invasive wels catfish

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Abstract: The generic diagnosis of the monotypic *Glanitaenia* is amended based on a detailed morphological examination of newly collected specimens of *G. osculata* (Goeze, 1782) (syn. *Proteocephalus osculatus*) found in wels catfish, *Silurus glanis* Linnaeus, 1758, from Neuchâtel, Switzerland. Several morphological characteristics of *G. osculata* are described for the first time or better specified, such as uterine development (type 2 according to the classification by de Chambrier *et al.*, 2004, 2015), the presence and peculiar position of a vaginal sphincter (previously not reported), its egg morphology, description of scolex microtriches and a dense network of osmoregulatory canals in the posterior part of the scolex and the anterior region of the neck (proliferative zone). The anterior position of the vagina, which opens anterior to the cirrus-sac, not ventral as typical for most of the closely related species of the *Proteocephalus* aggregate, may represent apomorphy of this taxon. *Glanitaenia osculata* is reported from Italy (River Po basin), Romania (River Danube delta) and Switzerland (Aare/Rhine River basin) for the first time. This expansion of the parasite distribution area may be related to a recent introduction of wels catfish to West Europe.

Keywords: Cestoda, *Glanitaenia osculata*, morphology, redescription, freshwater fish, geographical distribution, Europe.

INTRODUCTION

The cestode genus *Glanitaenia* de Chambrier, Zehnder, Vaucher & Mariaux, 2004 (Proteocephalidea: Proteocephalidae) was erected by de Chambrier *et al.* (2004) based on the phylogenetic position of its type and only species, *G. osculata* (Goeze, 1782) [syn. *Taenia osculata* Goeze, 1782; *Proteocephalus osculatus* (Goeze, 1782) La Rue, 1911; *Gangesia osculata* (Goeze, 1782) Reichenbach-Klinke, 1962] from wels catfish, *Silurus glanis* Linnaeus, 1758, among Palaearctic proteocephalideans. It grouped with morphologically distinct *Paraproteocephalus parasiluri* (Yamaguti, 1934), another parasite of silurid catfishes, thus making the genus *Proteocephalus* sensu stricto (called *Proteocephalus*-aggregate by de Chambrier *et al.*, 2004) paraphyletic. The erection of *Glanitaenia* as a separate genus was supported by phylogenetic analyses based on 5.8S + ITS2, V4 region of the 18S rRNA and 28S rRNA gene sequences (Hypša *et al.*, 2005; Scholz *et al.*, 2007; de Chambrier *et al.*, 2015).

Glanitaenia was differentiated from the other genera of the subfamily Proteocephalinae by the possession of a well-developed, functional apical sucker with a deep cavity (the apical sucker in other species of the *Proteocephalus*-aggregate is vestigial, without any cavity, or completely absent – see Scholz *et al.*, 1998). In the diagnosis of *Glanitaenia*, de Chambrier *et al.* (2004) relied mainly on the morphological features of *G. osculata* described by previous authors, especially Nybelin (1942), Freze (1965), Scholz & Hanzelová (1998), and Scholz *et al.* (1998). However, some morphological details, including characteristics that are recently considered to be of potential taxonomic and phylogenetic importance, such as the development of the uterus, relative size of the ovary, morphology of the eggs and terminal genitalia (the distal part of the vaginal canal), and the course of osmoregulatory canals (see de Chambrier *et al.*, 2012, 2015), were not provided.

Therefore, the generic diagnosis of *Glanitaenia* is amended in the present paper and the current distribution of *G. osculata* is reviewed based on new geographical

records from Europe and in relation to the current expansion of its fish host, wels eatfish, which is classified as an invasive species (Copp *et al.*, 2009).

MATERIAL AND METHODS

The present study is mainly based on morphological evaluation of 25 tapeworms found in a single wels catfish, *Silurus glanis* Linnaeus, 1758 (total length of 211 cm, weight of 68 kg) from Neuchâtel, Switzerland (River Aare basin) examined on 25 March 2010 by the senior author (A. de C.). Specimens for morphological study were fixed immediately after dissection of the host with hot 4% neutral formaldehyde solution and then stored in 75% ethanol. They were stained with Mayer's hydrochloric carmine solution, dehydrated in a graded ethanol series, cleared with eugenol (clove oil) and mounted in Canada balsam. Pieces of strobila were embedded in paraffin wax, transversely sectioned at 12–15 µm, stained with Weigert's haematoxylin and counterstained with 1% eosin B (acidified with five drops of pure acetic acid for 100 ml solution) (de Chambrier, 2001; Oros *et al.*, 2010). Voucher specimens have been deposited in the collection of the Natural History Museum in Geneva (acronym MHNG-PLAT; Collection numbers 68395–68397, 68699, 68700, 68709, 84707–84712, 91260) and in the helminthological collection of the Institute of Parasitology, Biology Centre of the Czech Academy of Sciences in České Budějovice (acronym IPCAS; Collection number C-49/1).

Scolecocytes of two specimens were prepared for scanning electron microscopy (SEM) as follows: specimens were dehydrated in a graded ethanol series, then transferred to a graded amylacetate series, critical point-dried in CO₂, sputter-coated with gold and examined in a Zeiss DSM 940A electron microscope at the Natural History Museum, Geneva. Microthrix terminology follows that of Chervy (2009).

Eggs were studied in the water after their spontaneous release from gravid tapeworms found in *S. glanis* from the River Vltava at the Orlik water reservoir near Štědrónín, Czech Republic, examined by T. S. on 13 October 1997 (host field nos. 2244 & 2245 – see below) and used for experimental infection of copepods (see Scholz, 1999). Measurements of egg envelopes, oncosphere and embryonic hooks are expressed in micrometres (µm) as range with the mean ± standard deviation and number of measurements in parentheses.

In addition, the following comparative material of *G. osculata* from *S. glanis* deposited in IPCAS was studied:

(i) 5 specimens from the Rivers Latorica in Slovakia and Tisa near Szolnok and Kőtelek (Hungary) (see Scholz, 1989);

(ii) tapeworms from the Orlik water reservoir on the River Vltava at Štědrónín, South Bohemia, Czech Republic, collected on 12 May 1996 (8 specimens; host field No. FM5504), 18 September 1996 (1 spec.), 22 May 1997 (6 spec.; Nos. 2146 & 2147), 4 June 1997 (34 spec.; No. 2186), 11 June 1997 (2 spec.; Nos. 2241–2243) and 13 October 1997 (8 spec.; Nos. 2244 & 2245) (see Scholz *et al.*, 1998; Scholz & Hanzelová, 1998);

(iii) 1 specimen from Horusický fishpond, South Bohemia, Czech Republic (Moldau/Elbe River basin) collected on 19 October 2009;

(iv) 4 specimens from Bodensee, Germany, collected in 1999 by Alexander Brinker;

(v) 1 specimen from River Po in Ferrara, Italy, collected in July 2009 by Bahram S. Dezfouli;

(vi) 1 specimen from Chilia Branch of the Danube River, Romania, collected in July 2013 by Petr Horák (all specimens listed above – IPCAS C-49/1).

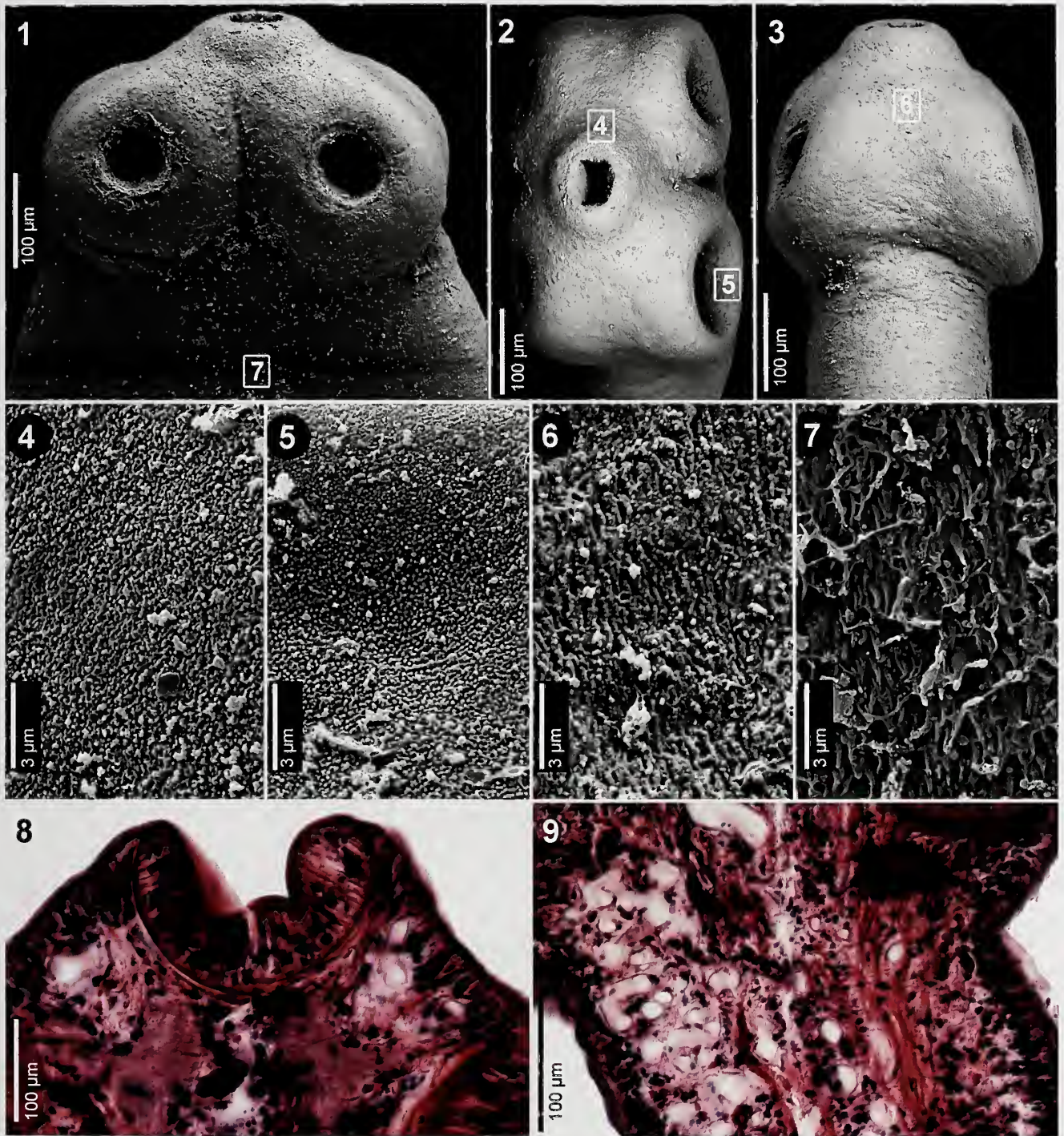
Relative size of the ovary, i.e. the proportion of its size in relation to the size of the proglottid, was calculated as outlined by de Chambrier *et al.* (2012). A copy of the illustration of the proglottid was cut out and weighed using a high precision balance (Mettler AE 163). Then a copy of the ovary itself was cut out and weighed, and the proportion of its weight to that of the entire proglottis was calculated (in %).

RESULTS

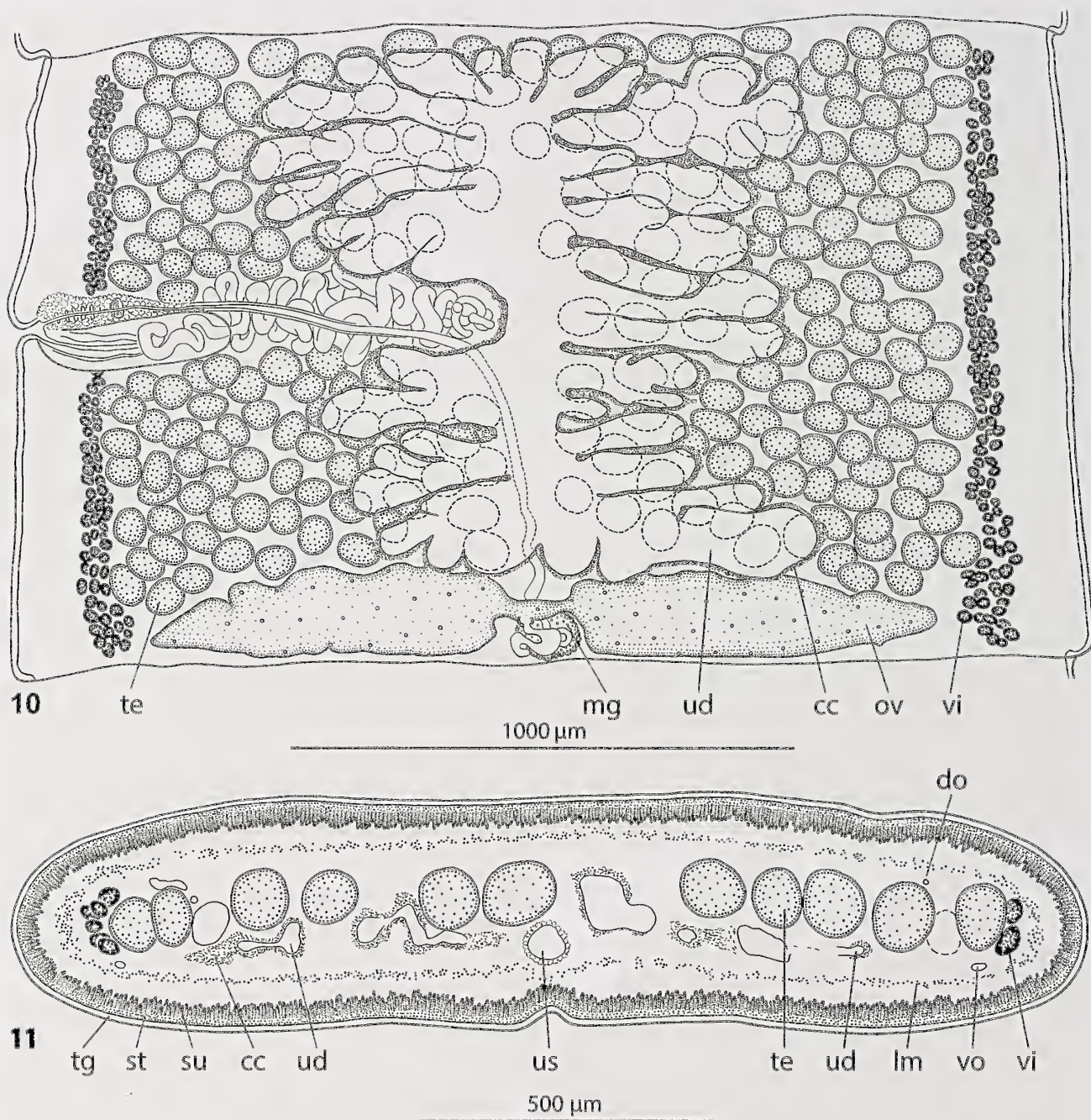
Examination of newly collected cestodes from Switzerland as well as voucher specimens from the Czech Republic, Germany, Hungary, Italy, Romania and Slovakia made it possible to supplement the morphological description of *Glanitaenia osculata*, with morphological data, which were previously not reported or not described sufficiently (Figs 1–15).

1. Development of the uterus

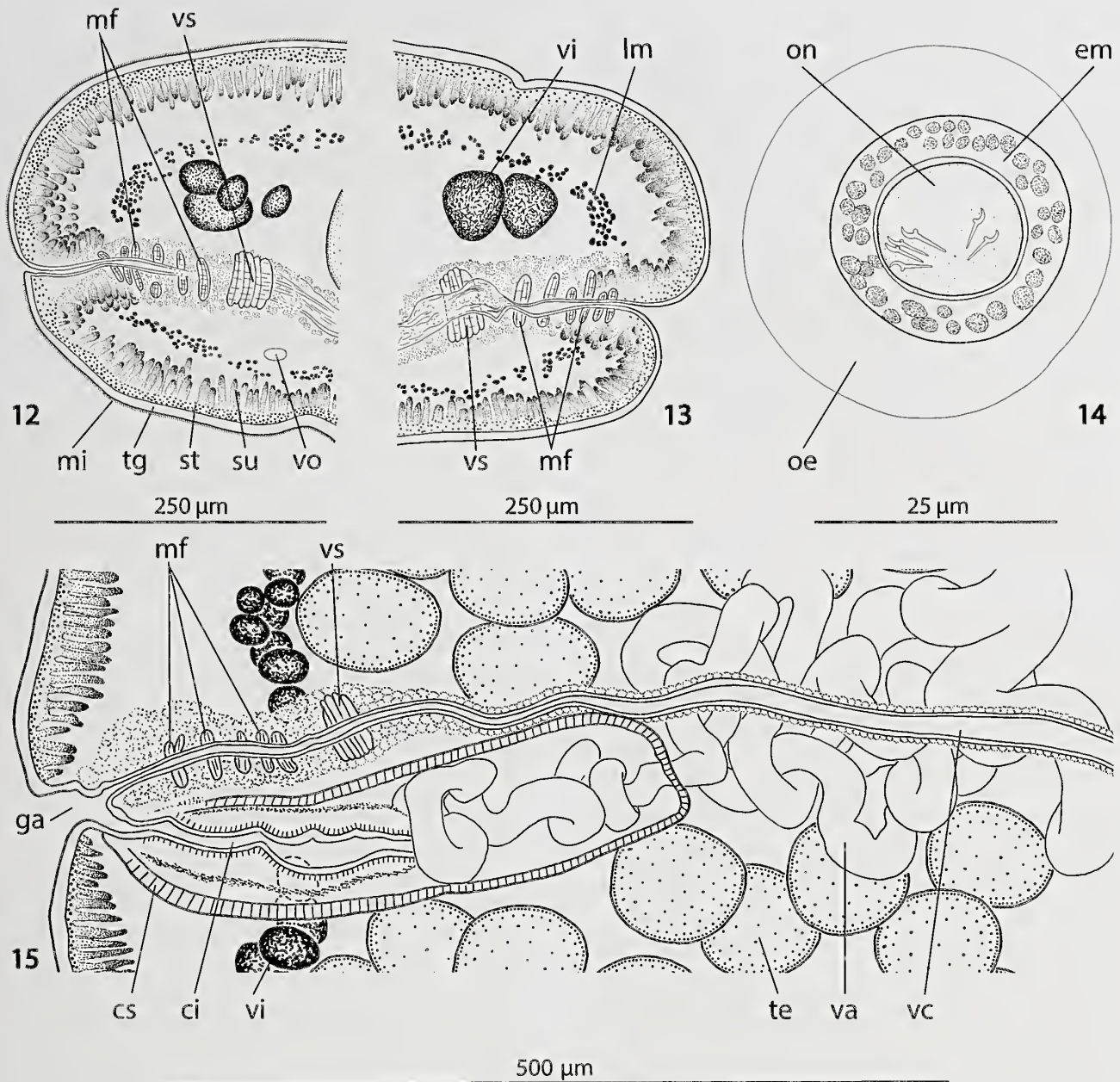
The uterine development of *G. osculata* is of type 2 according to the classification of de Chambrier *et al.* (2004, 2015). In immature proglottids, the uterine stem is lined by numerous weakly-staining cells, sometimes difficult to observe, on both sides. Thereafter, elongated ramified digitations appear lateral to the stem; their apical part contains undifferentiated chromophilic cells. In the last immature proglottids, the lumen of the uterine stem occupies up to 34% of the proglottid width. In mature proglottids, the lumen gradually extends from its base to the apex of each digitate diverticulum and occupies up to 44% of the proglottid width; the apex is lined with numerous chromophilic cells. Lateral ramified diverticula enlarge in gravid proglottids, occupying up to 59% of the proglottid width (Figs 10, 11).



Figs 1-9. *Glanitaenia osculata* from *Silurus glanis*, Switzerland. 1-7. Scanning electron micrographs (INVE-PLAT-91260). (1) Scolex, dorsoventral view. (2) Scolex, apical view. (3) Scolex, lateral view. (4) Acicular filitrichs on the apex of the scolex. (5) Papilliform filitrichs on the internal surface of suckers. (6) Capilliform filitrichs between the suckers. (7) Gladiate spinitrichs on the external surface of the proliferation zone (neck). (8, 9.) Photomicrographs of longitudinal sections of the scolex (INVE-PLAT-91260). (8) Detail of the apical part of the scolex showing an apical sucker. (9) Detail of the dense network of osmoregulatory canals in the posterior part of the scolex and the anterior part of the neck (proliferation zone).



Figs 10, 11. *Glanitaenia osculata* from *Silurus glanis*, Switzerland. (10) Pregravid proglottid, ventral view (MHNG-PLAT-84710). Note the shape of the ramified lateral diverticula of the uterus. (11) Cross section of a pregravid proglottid at the level of the preporal region. Abbreviations: cc: chromophilic cells; do: dorsal osmoregulatory canal; lm: internal longitudinal musculature; mg: Mehlis' glands; ov: ovary; st: subtegumental muscle fibres; su: subtegumental cells; te: testes; tg: tegument; ud: uterine diverticula; us: uterine stem; vi: vitelline follicles; vo: ventral osmoregulatory canal.



Figs 12-15. *Glanitaenia osculata* from *Silurus glanis*, (12, 13) Cross sections of the poral part of a pregravid proglottid at the level of the vagina (MHNG-PLAT-68397). Note the presence of a proximally situated vaginal sphincter and more distally situated muscles surrounding the vaginal canal. (14) Egg spontaneously released from a gravid tapeworm collected in the Czech Republic. (15) Detail of the cirrus-sac and the distal (terminal) part of the vaginal canal (MHNG-PLAT-84710). Abbreviations: ci: cirrus; cs: cirrus-sac; em: bi-layered embryophore; ga: genital atrium; lm: internal longitudinal musculature; mf: muscle fibres; mi: microtriches; oe: outer envelope; on: oncosphere; st: subtegumental muscle fibres; su: subtegumental cells; te: testes; tg: tegument; va: vas deferens; vc: vaginal canal; vi: vitelline follicles; vo: ventral osmoregulatory canal; vs: vaginal sphincter.

2. Relative size of the ovary

The surface of the ovary of *G. osculata* represents 7.5-8.7% of the total surface of the proglottids in the newly collected material, and 10.6-10.7% in proglottids illustrated by Scholz & Hanzelová (1998) (calculated from fig. 17A, C in that paper).

3. Vaginal sphincter

The distal part of the vaginal canal of *G. osculata* is surrounded by a small circular sphincter. Unlike most other proteocephaline cestodes, it is situated more medially, ventral or medioventral to vitelline follicles (Figs 12, 13, 15), not close to the genital atrium as in other taxa. In addition to this circular sphincter of a typical appearance (ring-like, circular sphincter), the distal (terminal) part of the vaginal canal is surrounded by a few separated bundles of muscle fibres (Figs 12, 13, 15).

4. Position of the vaginal canal

The vaginal canal is almost always anterior to the cirrus-sac (in 163 of 166, i.e. 98.1%, of observed proglottids; Fig. 15), thus not overlapping it on its ventral side. In most species of the *Proteocephalus* aggregate, the vaginal canal opens at the same level as the cirrus pore, thus the distal part of the vaginal canal overlaps the terminal part of the cirrus-sac on its ventral side (Scholz & Hanzelová, 1998).

5. Egg morphology

Eggs released spontaneously to the water are spherical, with a hyaline outer envelope, 34-43 (39.3 ± 2.3 ; $n = 27$) in diameter; diameter of granular embryophore 23-27 (25.3 ± 1.2 ; $n = 24$) (Fig. 14). Oncosphere subspherical, 15-18 (16.7 ± 0.9 ; $n = 20$) long and 14-17 (14.7 ± 0.8 ; $n = 20$) wide, with three pairs of embryonic hooks (Fig. 14); lateral hooks slightly shorter, 6.5-7.7 (7.1 ± 0.3 ; $n = 25$) long, than median hooks, 6-7.5 (6.7 ± 0.4 ; $n = 20$) long.

6. Osmoregulatory canals

In the posterior part of the scolex and the anterior part of the neck region of *G. osculata*, osmoregulatory canals are strongly convoluted and form a dense network of anastomosed canals (Fig. 9).

7. Number of testes

The number of testes in the newly collected specimens is 222-281 per proglottid ($x = 249$; $n = 10$; Fig. 10).

8. Microtriches

The apical part of the scolex is covered with acicular filitriches (Fig. 4) and the internal surface of the suckers with papilliform filitriches (Fig. 5); capilliform filitriches are present between the suckers (Fig. 6) and gladiate spinitriches on the external surface of the proliferation zone (neck) (Fig. 7).

On the basis of our new observations, we amend the diagnosis of *Glanitaenia* as follows:

Glanitaenia de Chambrier, Zehnder, Vaucher & Mariaux, 2004 – amended diagnosis

Diagnosis: Proteocephalidea, Proteocephalidae. Large tapeworms with numerous slightly craspedote proglottids, wider than long including for pregravid and gravid proglottids. Inner longitudinal musculature well developed, formed by highly anastomosed, numerous bundles of muscle fibres. Scolex unarmed, with four uniloculate suckers, with convoluted osmoregulatory canals in its posterior part. Apical sucker well developed, strongly muscular, with deep cavity; apical part lined with numerous gland cells. Neck region (proliferation zone) long, containing extensively developed, convoluted osmoregulatory canals with numerous anastomoses in its anterior part. Immature proglottids numerous, begin at considerable distance posterior to scolex. Testes numerous, medullary, in one continuous field and in one layer, exceptionally with a few testes in second incomplete layer. Ovary medullary, numerous, bilobed, relatively large in relation to surface of proglottids. Vagina opening to common genital atrium anterior to cirrus-sac; vaginal canal with circular vaginal sphincter situated ventral to ventrolateral to vitelline follicles; terminal (distal) part of vaginal canal encircled by separated bundles of muscle fibres. Genital pore slightly pre-equatorial. Vitelline follicles lateral, occupying almost entire proglottid length. Uterus medullary, ventral, with ramified lateral diverticula. Development of uterus of type 2. Parasites of siluriform fish in Palaearctic Region. Type and only species: *Glanitaenia osculata* (Goeze, 1782) de Chambrier, Zehnder, Vaucher & Mariaux, 2004 [synonyms *Taenia osculata* Goeze, 1782; *Proteocephalus osculatus* (Goeze, 1782) La Rue, 1911; *Ichthyotaenia skorikowi* von Linstow, 1904; *Proteocephalus skorikowi* (von Linstow, 1904) La Rue, 1911; *Gangesia osculata* (Goeze, 1782) Reichenbach-Klinke, 1962].

DISCUSSION

In the present study, generic diagnosis of one of the earliest diverging taxon of the subfamily Proteocephalinae (see de Chambrier *et al.*, 2015) is amended, based on the examination of newly collected and museum material of its type and only species,

Glanitaenia osculata. This species was poorly known since its description as *Taenia osculata* by Goeze (1782) and La Rue (1911, 1914) placed it (as *Proteocephalus osculatus*) among *species inquirendae*, partly because it was confused with another specific parasite of wels catfish, *Silurotaenia siluri* (Batsch, 1786) (Proteocephalidea: Gangesiinae). Nybelin (1942) was the first who confirmed the validity of *P. osculatus* and provided a most detailed description of its morphology at a given time.

Freze (1965), who studied extensive material of *P. osculatus* (= *Glanitaenia osculata*) from the former Soviet Union, stated that “Nybelin’s description of *P. osculatus* [= *G. osculata*] insufficiently reflects the boundaries of its morphological variations, although Freze’s material in general corresponds to this description and pertains to the same species.” Scholz *et al.* (1998) provided detailed data on the scolex morphology of *G. osculata* (as *P. osculatus*) including SEM micrographs, and Scholz & Hanzelová (1998) redescribed the species based on newly collected specimens from the Czech Republic.

In the present study, some morphological and biometrical data are provided for the first time, which made it possible to amend the generic diagnosis of *Glanitaenia*. de Chambrier *et al.* (2004) have demonstrated potential importance of the uterine development as one of very few morphological characteristics that may reflect the evolutionary history of the order (see also de Chambrier *et al.*, 2015). The former authors classified the development of the uterus of *G. osculata* as type 2 (see fig. 1 in de Chambrier *et al.*, 2004), but did not provide any details. Surprisingly, the shape of the developed uterus of *G. osculata* with ramified lateral diverticula is most similar to that of *Ageneiella brevifilis* de Chambrier & Vaucher, 1999, a parasite of the achenipterid catfish *Ageneiosus inermis* (Linnaeus) in the Neotropical Region (see fig. 31 in de Chambrier & Vaucher, 1999), which belongs to a most derived clade of proteocephalidean cestodes (de Chambrier *et al.*, 2015).

The new material of *G. osculata* also enabled us to provide data on the relative size of the ovary (see de Chambrier *et al.*, 2012). The surface of the ovary of *G. osculata* represents 7.5–8.7% of the total surface of proglottids (and 10.6–10.7% in specimens illustrated by Scholz & Hanzelová, 1998), which well corresponds to the values in other species of proteocephalideans from teleost fishes and it is markedly larger than those in most species of *Ophiotaenia* La Rue, 1911 from reptiles (see table 1 in de Chambrier *et al.*, 2015).

A novelty of the present study is a detailed description of a vaginal sphincter in *G. osculata* and its peculiar position and morphology. Indeed, Nybelin (1942) also described a small vaginal sphincter and illustrated it in his fig. 3, but he did not provide any details. In contrast, Scholz & Hanzelová (1998) did not report this structure at all. They illustrated a thick layer of cells lining the terminal (distal) part of the vaginal canal in their fig. 9G (cross

section at the level of the vagina), but these cells were not interpreted as a vaginal sphincter. Similarly, no sphincter was illustrated in the terminal part of the vaginal canal (fig. 16I in that paper).

One of the reasons why Scholz & Hanzelová (1998) did not report the vaginal sphincter, which is actually present in the specimens studied by these authors, could be its unusual position. It is situated at the level of vitelline follicles, i.e. much more medially than in related taxa such as *Proteocephalus longicollis* (Zeder, 1800) and *P. percae* (Müller, 1780), in which the sphincter is close to the genital atrium (see figs 14G, 18E, F and 20 H, I in Scholz & Hanzelová, 1998).

The terminal part of the vaginal canal of *G. osculata*, which is surrounded by a medially situated circular vaginal sphincter of a typical shape (ring-like sphincter) and a few separated bundles of muscle fibres situated more distally, somewhat resembles that of phylogenetically distant species from Neotropical catfish, *Mariauxiella piscatorum* de Chambrier & Vaucher, 1999 (see fig. 87 in de Chambrier & Vaucher, 1999).

The eggs of *G. osculata* are described and illustrated for the first time in the present paper, even though Scholz (1999) studied early phases of the developmental cycle of the species. However, he provided only data on metacestodes (plerocercoids) from experimentally infected copepods 12 and 21 days post infection. In fact, the eggs of *G. osculata* resemble those typical of most species of the *Proteocephalus* aggregate (see Scholz, 1999).

The anterior part of the body of *G. osculata*, specifically the posterior part of its scolex and the anterior part of a very long proliferative zone (neck region), contains strongly convoluted osmoregulatory canals that form a dense network of anastomosed canals. Scholz *et al.* (1998) observed similar networks in the scolex of most Palaearctic species of the *Proteocephalus* aggregate, but they did not focus on the presence of these canals in the proliferative zone. In addition, the canals seem to be much more developed in *G. osculata* compared to those in species of the *Proteocephalus* aggregate (see figs 1K, 3G, I, J, 5E, Q in Scholz *et al.*, 1998). A dense network of osmoregulatory canals situated in the posterior part of the scolex and the anterior part of the neck region was also observed in phylogenetically distant *Proteocephalus regoi* de Chambrier, Scholz & Vaucher, 1996, a parasite of *Hoplias malabaricus* (Bloch) (Characiformes: Erythrinidae) in the Neotropical Region (see figs 1 and 3 in de Chambrier *et al.*, 1996), and in *Sandonella sandoni* (Lynsdale, 1960) from *Heterotis niloticus* (Cuvier) (Osteoglossiformes: Arapaimidae) in the Ethiopian Region (see fig. 2 in de Chambrier *et al.*, 2008). Function of these canals and the reason of their concentration in the scolex or in the proliferative zone are not known. Cestodes seem to be osmoconformers whose excretory system plays little or no role in osmoregulation and is largely excretory (Smyth & McManus, 1989).

Glanitaenia osculata belongs to the largest cestodes of teleost fishes, with a total length reaching up to 1 m (Lühe, 1910); the longest specimen found in the present study was 74 cm long (a tapeworm from Switzerland). The body of *G. osculata* consists of numerous, rather large proglottids that contain many testes. Even though these are mostly in a single layer, their counting is difficult due to their high number and a well-developed longitudinal musculature. Nybelin (1942) reported 276–291 testes per proglottid, Freze (1965) 180–424 testes (usually about 250), but Scholz & Hanzelová (1998) only 105–171 testes. In the present study, 222–281 testes ($x = 249$, $n = 10$) were counted based on illustrations of individual proglottids, which is the most precise method of counting the testes.

This species forms, together with *Paraproteocephalus parasiluri* (Yamaguti, 1934), type and single species of *Paraproteocephalus* Chen in Dubinina, 1962 (see de Chambrier *et al.*, 2004, 2015; Scholz *et al.*, 2007). Species of both monotypic genera differ from each other in their scolex and strobilar morphology, especially in the presence/absence of a metascolex (absent in the former species versus well-developed in *P. parasiluri*, which was even placed in the subfamily Corallobothriinae – Freze, 1965), the position of bands of vitelline follicles ('typically' vertical alongside margins of proglottids

in *G. osculata* versus L-shaped, with most follicles forming a transverse band lateral to the ovary in the latter species – see figs 6 & 7 in Shimazu, 1993), and uterine diverticula (lateral in the former species as in a majority of proteocephalideans versus forming anterior and posterior branches from the transversely situated uterine stem in *P. parasiluri* – figs 6 & 7 in Shimazu, 1993).

Glanitaenia osculata resembles species of the *Proteocephalus* aggregate in the morphology of its scolex, which is devoid of any metascolex, and shape of the strobila and its proglottids, which are only slightly wider than long. It can be distinguished from species of the *Proteocephalus* aggregate by a much more developed apical sucker (versus vestigial or absent in species of the latter group – see Scholz *et al.*, 1998) and by the anterior position of the vaginal canal in relation to the cirrus-sac (ventral to the terminal part of the sac in most species of the *Proteocephalus* aggregate). In addition, *G. osculata* is much bigger and more robust than the species of the *Proteocephalus* aggregate and its proglottids contain much more proglottids, especially immature ones, and more testes (Scholz & Hanzelová, 1998; present study). This tapeworm has been reported from the following countries of Europe and Palaearctic Asia: Bulgaria, Czech Republic, Germany, Hungary, Latvia, Lithuania, Poland, Russia, Slovakia, Sweden, Ukraine, United Kingdom, former Yugoslavia, Azerbaidzhan, Georgia, Iraq and Turkey (Fig. 16; see also Scholz & Hanzelová, 1998 and Gibson *et al.*, 2005 [but misidentification of *Postgangesia inarmata* de Chambrier, Al-Kallak & Mariaux, 2003 and *Postgangesia hemisphaerous* (Rahemo & Al-Niaeemi, 2001) in Iraq cannot be excluded]).

Glanitaenia osculata is a specific parasite of wels catfish, which is currently considered to be an invasive species and has recently been introduced to the western and southwestern Europe including northern Italy, Spain, France, Germany and England (Copp *et al.*, 2009; Fig. 16). Therefore, it is possible that new geographical records from two of these countries (the River Po in Italy and the River Rhine basin in Germany – River Aare is a tributary of the Rhine joining it in Koblenz, at the Swiss-German border) are a result of this recent expansion of the wels catfish throughout Europe (Fig. 16).



Fig 16. Geographical distribution of *Glanitaenia osculata* (Goeze, 1782) in Europe. Countries with previous records indicated by triangles; new geographical records (Italy, Romania and Switzerland) highlighted by asterisk; the original distribution area of wels catfish (grey silhouette; bordered by dashed line) and newly colonized regions of Europe (white silhouette; bordered by dotted line; modified from Copp *et al.*, 2009).

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Studies on Afrotropical Crambinae (Lepidoptera, Pyraloidea, Crambidae): Notes on the genus *Aurotalis* Bleszyński, 1970

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Abstract. The Afrotropical genus *Aurotalis* Bleszyński, 1970 is briefly reviewed and two new species are described and illustrated: *A. cristata* sp. n. and *A. dicksoni* sp. n. *Charltona argyrastis* Hampson, 1919 is transferred to *Aurotalis* Bleszyński, 1970. A list of the known species and a diagnosis of each species are given. Illustrations of new diagnostic morphological characters are presented.

Keywords: Africa - *Ancylolomia* - *Charltona* - distribution - new combination - new species - *Prionotalis*.

INTRODUCTION

The genus *Aurotalis* was erected by Bleszyński (1970: 20) for two species, *A. dionisa* and *A. nigrisquamalis*. Subsequently, *Euchromius delicatalis* was transferred to *Aurotalis* by Schouten (1992: 197) and *A. hermione* and *A. similis* were described by Bassi (1999).

While studying afrotropical Crambinae collected during the last years, I found new series of specimens of this genus, this both in the field and in several museum collections. I am now able to add two new species to this very characteristic genus and to treat all previously described species by illustrating their diagnostic morphological characters.

MATERIAL AND METHODS

The descriptions are based on all available specimens. The length of the labial palpus is compared to the maximum diameter of the composite eye in side view. Genitalia slides were made using standard procedures (Robinson, 1976), and the terminology follows Klots (1970) for genitalia and Landry (1995) for tympanal organs. All specimens studied came from the collections listed in the abbreviations list.

Abbreviations used:

- BMNH Natural History Museum, London, UK.
- CGB Graziano Bassi private collection, Avigliana (Torino), Italy.
- GS...GB Genitalia slide... G. Bassi.
- MFNB Museum für Naturkunde Berlin, Germany.
- MHNG Muséum d'histoire naturelle, Genève, Switzerland.

- TMSA Distong National Museum of Natural History (formerly the Transvaal Museum), Pretoria, RSA.
- RSA Republic of South Africa.

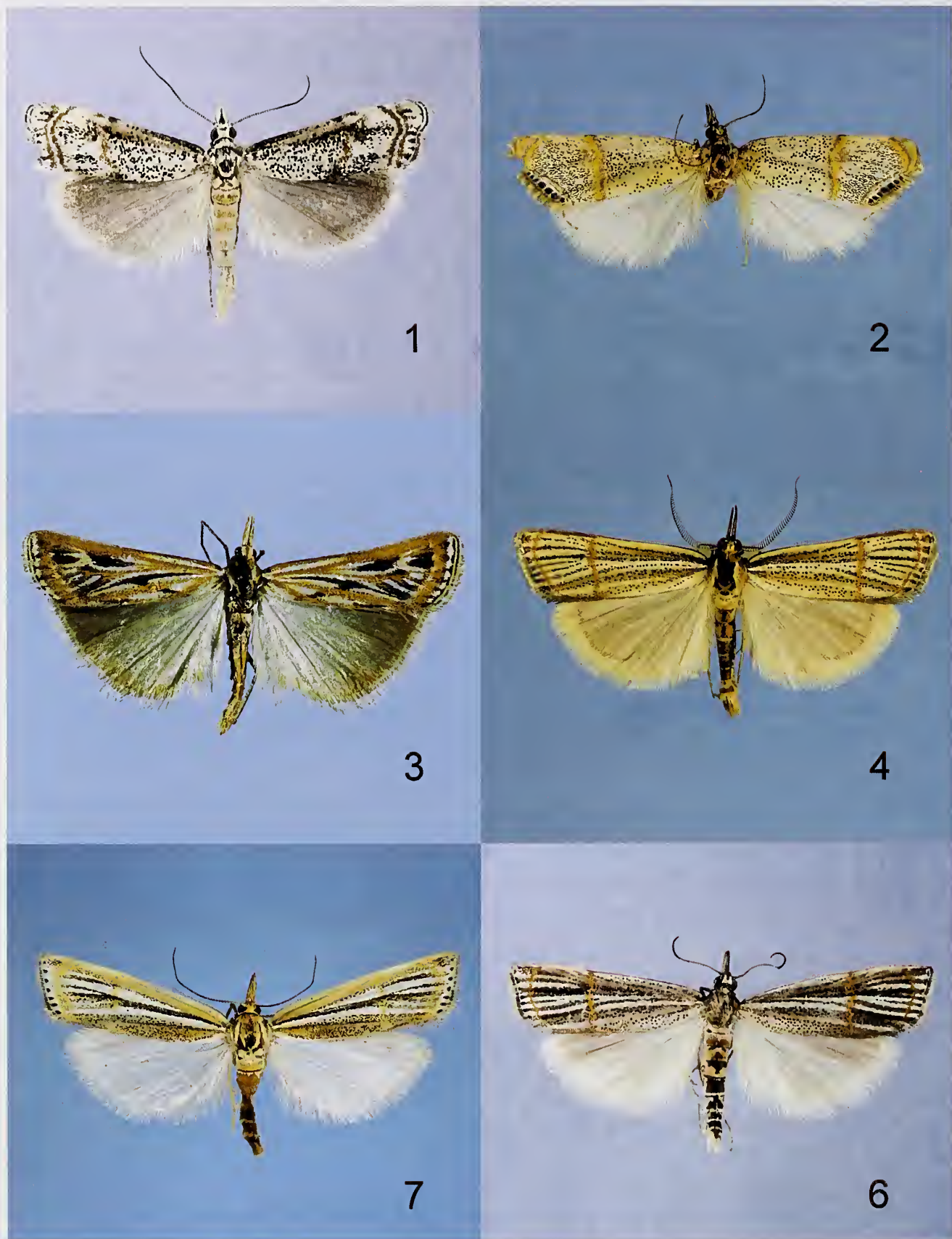
TAXONOMY

Genus *Aurotalis* Bleszyński, 1970

Aurotalis Bleszyński, 1970: 20, type species *Aurotalis dionisa* Bleszyński, 1970, by original designation.

Diagnosis: So far, the only diagnostic character for *Aurotalis* is the presence in female genitalia (on the papillae anales) of strong setae originating from the tips of short projections in the highly corrugated upper surface. Adults are distinguished from those of the most closely related genera in having long labial palpi, associated with the forewing colour being at least partly white.

Redescription (Figs 1-6): Ocelli and chaetosemata well developed. Labial palpi three times or more as long as the maximum diameter of the composite eye in side view. Forewing at least partly white. Wing venation of *A. nigrisquamalis*, slightly different from that of *A. delicatalis* as illustrated by Schouten (1992: 192, fig. 2): in forewing R1 present and free, not connected to Sc; R2 free; R3 connected with R4 at 3/4; R5 free; M1 from middle of cell; cell opened between R5 and M2; M2 and M3 not stalked; CuA1 from lower corner of cell; CuA2 at distal 1/3 of cell; 1A+2A strong. Hindwing with Sc connected to Rs at distal 1/3; M1 free, visible only distally; M3 connecting to M2 and Cu1 at distal 1/3, Cu2 connecting to M2 at half of



Figs 1-6. Adults of *Aurotalis* spp. (1) *A. cristata* sp. n., male paratype, Zimbabwe, wingspan 20 mm. (2) *A. delicatalis* (Hampson), female, RSA, wingspan 26 mm. (3) *A. dicksoni* sp. n., holotype, wingspan 28 mm. (4) *A. nigrisquamalis* (Hampson), male, RSA, wingspan 28 mm. (5) *A. dionisa* Bleszyński, female, Namibia, wingspan 28 mm. (6) *A. similis* Bassi, male, Zimbabwe, wingspan 28 mm.

length; a1, a2 and a3 unforked. Colours tend to become faint in old specimens. Abdominal segment VIII, simple and narrow in the female, shows distinguishing sclerotizations in the male (Figs 16-19, 30).

Tympanal organs (Fig. 23-25). Transverse ridge rounded. Tympanic bridge well developed, lightly sclerotized. Tympanic drum ovoid. Venulae secundae well developed, concave. The well developed and lightly sclerotized tympanic bridge seems to be the more constant feature through the genus, other characteristics being rather variable.

Male genitalia (Figs 9, 13-15, 26, 29, 30): Uncus more or less apically downcurved. Gnathos strongly upcurved while being straight, simple or bifid. Tegumen and valva stout being tapering. Vinculum without or with small dorsal projection. Pseudosaccus small. Phallus stout to elongate, with maximum two cornuti.

Female genitalia (Figs 12, 20-22, 27, 28): Papillae anales with strong setae on upper surface, originating from tips of short projection of highly corrugated membrane. Both apophyses strongly developed. Ostium bursae and sterigma membranous. Corpus bursae suboval, without signa.

Systematic position: This genus is part of the *Ancylolomia* Hübner complex of genera (Bassi,

2013). Bleszyński (1970: 20) claimed that is closest to *Conotalis* Hampson, but the most closely related genus seems to be *Prionotalis* Hampson 1919b: 152, as in *Conotalis* species the phallus has a long cornutus, a feature never seen in *Aurotalis*. The relatively short valva, strong vinculum and tegumen, phallus about as long as valva in male genitalia suggest that both *Aurotalis* and *Prionotalis* are closely related to the *locupletella* group of *Ancylolomia* (Figs 7-9). In the same way, female genitalia are similar in these three groups in the stout papillae anales and corpus bursae, and in the ductus ejaculatorius departing from the corpus bursae (Figs 10-12).

Biology: Early stages are unknown, probably feeding in grasslands. The adults are easily attracted by light.

Distribution: The genus seems to be distributed through the highlands and mountains from Austral Africa to Kenya. However, only one species, *A. nigrisquamalis* (Hampson) is a common moth in RSA and Swaziland.

Remarks: The morphological character evolution appears very diversified, especially those of the genitalia.

Key to the species of *Aurotalis* Bleszyński

- | | | |
|----|--|------------------------------------|
| 1a | Forewing ground colour white | 3 |
| 1b | Forewing ground colour not white | 2 |
| 2a | Forewing ground colour yellow | 5 |
| 2b | Forewing ground colour ochre brown; hindwing brown suffused white basally; male genitalia with juxta u-shaped and phallus clearly divided into two parts | <i>A. dicksoni</i> sp. n. |
| 3a | Median and subterminal fasciae on forewing present | 4 |
| 3b | Fasciae on forewing absent, ground colour almost entirely white, with only a fulvous tinge along costa; hindwing brown margined white; female genitalia with a globular wrinkled extension at the end of ductus bursae | <i>A. argyrastis</i> (Hampson) |
| 4a | Forewing with orange median fascia, subterminal fasciae ill-defined, dorsum chestnut brown and three large dots at tornus; hindwing light brown; male genitalia with two cornuti on vesica | <i>A. hermione</i> Bassi |
| 4b | Forewing with double subterminal fasciae; hindwing grey suffused white; male genitalia with gnathos stout with dorsal crest-like process and juxta with finger-like dorsal process; female genitalia with papillae anales dorsally bulged, ductus bursae short and sclerotized and corpus bursae proximally spinulate | <i>A. cristata</i> sp. n. |
| 4c | Forewing with single subterminal fasciae; hindwing white suffused grey; male genitalia with vesica with single spatulate cornutus; female genitalia with rather long ductus bursae, lightly sclerotized only close to corpus bursae | <i>A. similis</i> Bassi |
| 5a | Hindwing white | 6 |
| 5b | Hindwing yellow suffused grey and brown with yellow fringes; forewing with orange yellow median and subterminal fasciae; male genitalia with bilobed gnathos; female genitalia with papillae anales with ventral upturned tip | <i>A. nigrisquamalis</i> (Hampson) |
| 6a | Hindwing pure white; forewing with two longitudinal white lines and median and subterminal fasciae yellow; male genitalia with tapered cucullus and narrow and curved phallus; presence of feathery coremata; female genitalia with papillae anales straight margined and semicircular sclerotization in the ductus bursae | <i>A. dionisa</i> Bleszyński |
| 6b | Hindwing white suffused yellow; forewing with bicolored median fascia and terminal spots beneath vein 5; male genitalia with phallus stout, shorter than valva and vesica without cornuti; female genitalia with funnel-shaped ductus bursae and large corpus bursae | <i>A. delicatalis</i> (Hampson) |

***Aurotalis argyrastis* (Hampson, 1919) comb. n.**

Fig. 28

Charltona argyrastis Hampson, 1919b: 306, 307.

Holotype: ♂ [Kenya, 0°23'N, 34°29'E], Brit[ish] E[ast] Africa, N[orth] Kavirondo, Nasisi Hills, 4800 f[ee]t, 14.VI.1911, (S.A. Neave), 1912-92, GS 11157 BM (6001 Bleszyński), *Charltona argyrastis* type ♀ H[a]mps[o]n, BMNH(E) 1378093. Deposited in BMNH.

Type locality: Kenya, Nigeria.

Diagnosis: This species is easily separated from the other known members of the genus by virtue of its pale forewings. *A. delicatalis* (Hampson) (Fig. 2) and rubbed *A. nigrisquamalis* (Hampson) have pale forewings too, but they have smaller females (25 mm versus 30 mm). The female genitalia have an unusual wrinkled extension between the ductus and corpus bursae that is not found in any other species of the genus.

Additions to original description:

Female genitalia (Fig. 28): Papillae anales rather straight

marginated. Apophyses posteriores as long as apophyses anteriores. Ostium bursae funnel-shaped, membranous. Ductus bursae as long as corpus bursae, moderately sclerotized and distally with large globular and strongly wrinkled extension. Corpus bursae suboval. Ductus seminalis opening in globular extension of ductus bursae.

Distribution: Kenya, Nigeria.

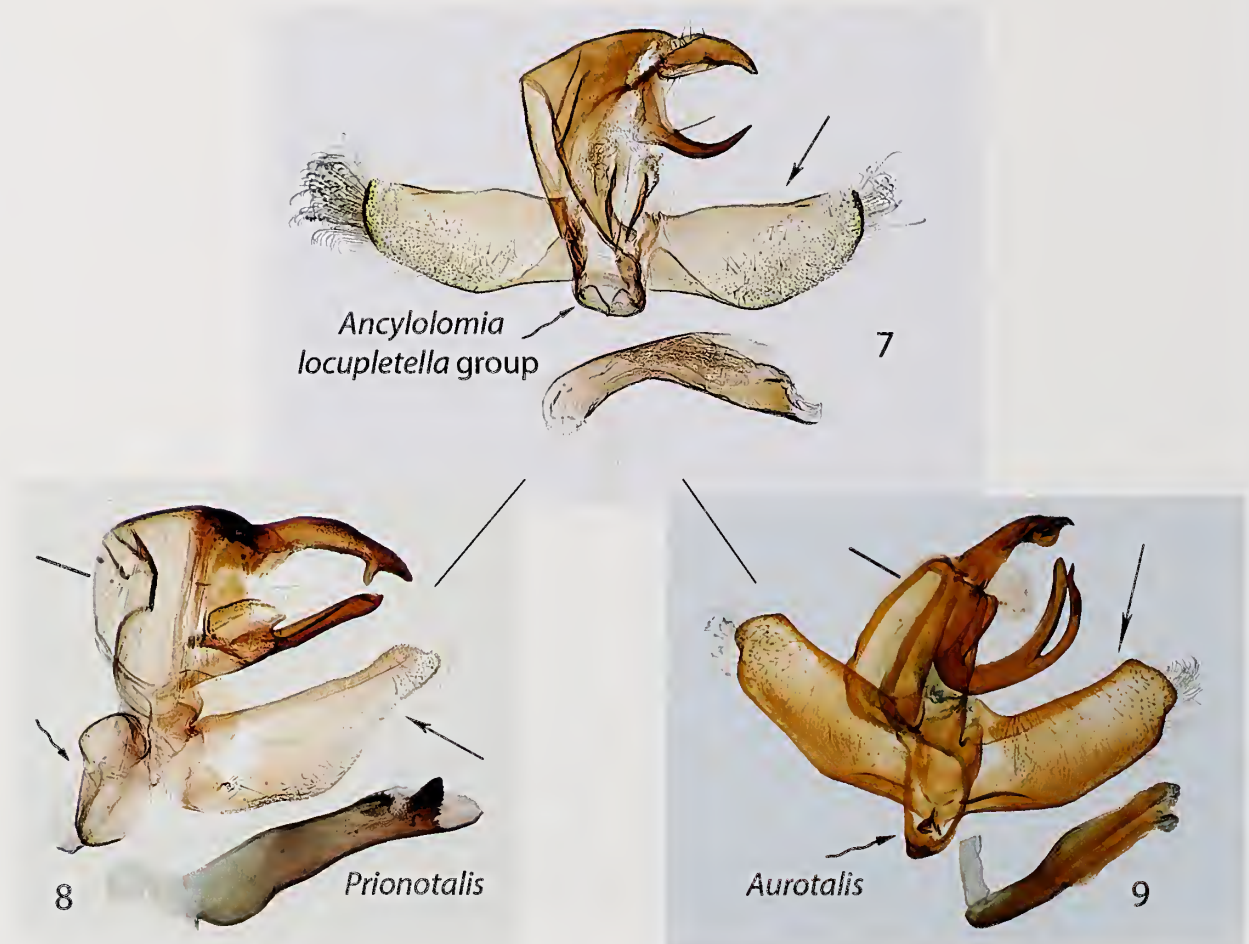
Remarks: Males are unknown. The second specimen known is a female from Northern Nigeria, Ropp Hills, 20.VII.1920, and has no abdomen.

***Aurotalis cristata* sp. n.**

Figs 1, 12, 17, 24, 26, 27

Holotype: ♀, Zimbabwe, Bulawayo, Matopo Nat[ional] Park [20°33'S, 28°30'E] 28.30.XI.1993, leg. Mey & Ebert, GS 4060.- GB; Holotypus *Aurotalis cristata* n. sp. G. Bassi det. 2002. Deposited in MFNB.

Paratypes: Zimbabwe: 2♀, 4♂, same data as holotype, GS 3840 GB; 1♀, S[outhern] Africa, Manicaland



Figs 7-9. Crambinae spp., male genitalia, differences among close genera. (7) *Ancyrolomia planicosta* Martin, RSA. (8) *Prionotalis balia* (Tams), Tanzania. (9) *Aurotalis cristata* sp. n., Zimbabwe. Arrow = valva; flash arrow = vinculum; thick bar = tegumen

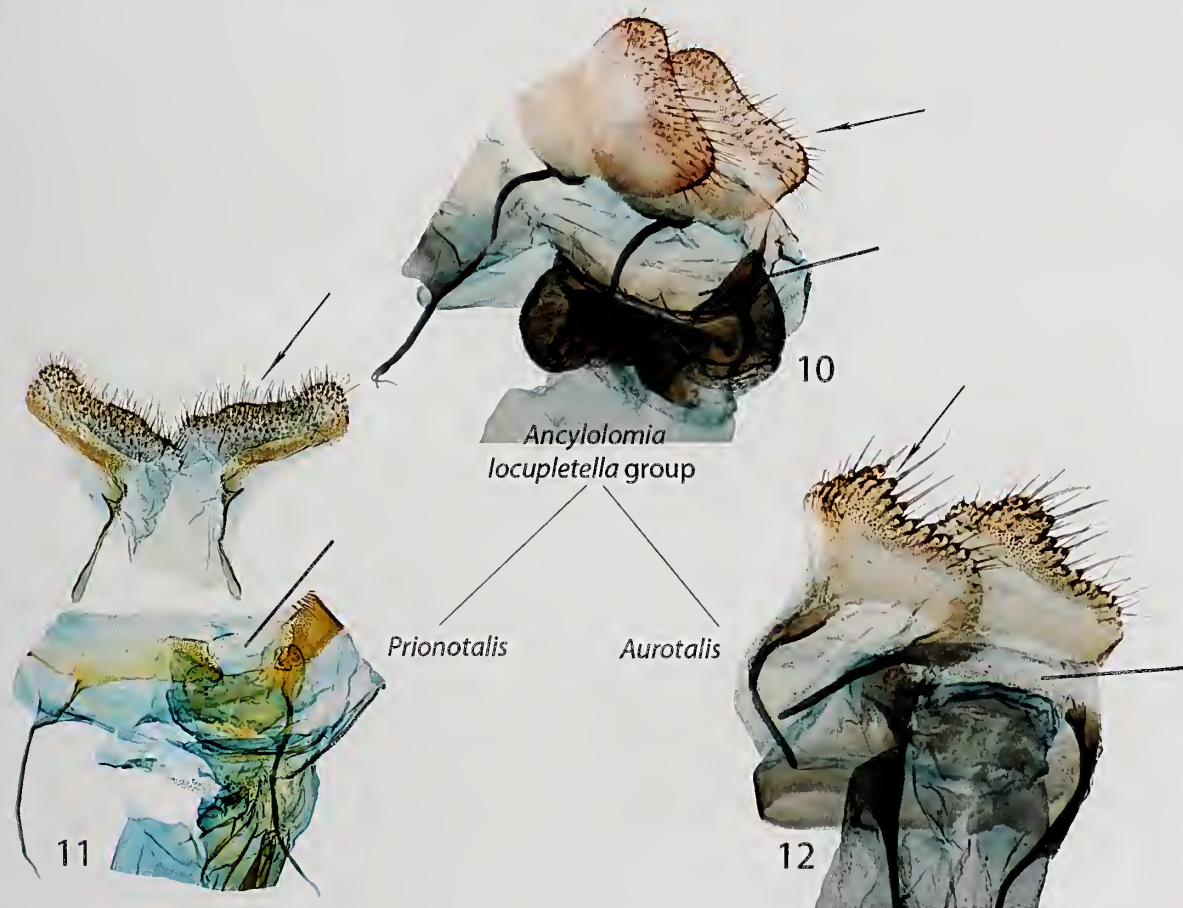
Prov[ince], Vukutu, 18°21'S32°36'E, h 1900 m, 1-3. XII.2010, Ustjuzhanin P. & Kovtunovich V. – 1♀, Zimbabwe, 15.III.1951, G. C. Clarke. – 1♀, Emangeni, Rhod[esia], 19.I. [19]18, A. J. T. Janse. – 1♂, Lundi, Rhod[esia], Nuanetsi Dist[rikt], 13.III.1976, M. J. Scoble; 1♀, Darwendale, 17-19.I.1955, D. W. Rorke. – RSA: 1♂, Messina, T[rans]v[aa]l, 20 m. South, II.1950, N. Mitton. – 2♂, Midw[est] L[ouis] Trichardt, Willie's [Wyllie's] Poort, 28 and 31.I. [19]25, A. J. T. Janse. – 1♀, 5♂, Blauwkoop, 30.I. [19]25, A. J. T. Janse, GS 4671 GB. – 1♀, 1♂, Nelspruit, 2.1910, H. G. Breijer. – 1♀, Skukuza, 2.XII.1974, L. Vari, GS 4661 GB. – 1♀, Buffelspoort, 15.XII. [19]24, A. J. T. Janse. Deposited in CGB, MHNG, MFNB and TMSA.

Diagnosis: At least in Zimbabwe, *A. cristata* (Fig. 1) co-occurs with *A. similis* Bassi (Fig. 6), but it is clearly smaller (14-20 mm versus 22-26 mm respectively), it has a double subterminal fascia and no longitudinal white lines. It shares a wingspan similar to males of *A. delicatalis* (Hampson), but it is darker, with

the forewing narrower and with the ground colour white. Male genitalia of *A. cristata* (Fig. 26) can be distinguished from those of congeners by the narrow, tapering and pointed uncus, the presence of a saccular process on the valva and the juxta subcylindrical and with a finger-like projection. The female genitalia (Figs 12, 27) are small and with a sclerotized ductus bursae, in comparison to the larger and membranous ductus bursae of *A. delicatalis* (Fig. 21).

Etymology: The name derives from the Latin *cristatus-a*, crested, and refers to the shape of the gnathos in the male genitalia.

Description (Fig. 1): Wingspan 14-20 mm. Labial palpi 3× longer than widest diameter of eye, black and white. Frons rounded, clearly produced, black with outer margin white. Antennae serrate, narrower in female, brown; costa with narrow band of scales white and black. Ocelli and chetosemata poorly developed. Head with raised scales, medially black, laterally white. Patagia white with basal scales black. Tegulae



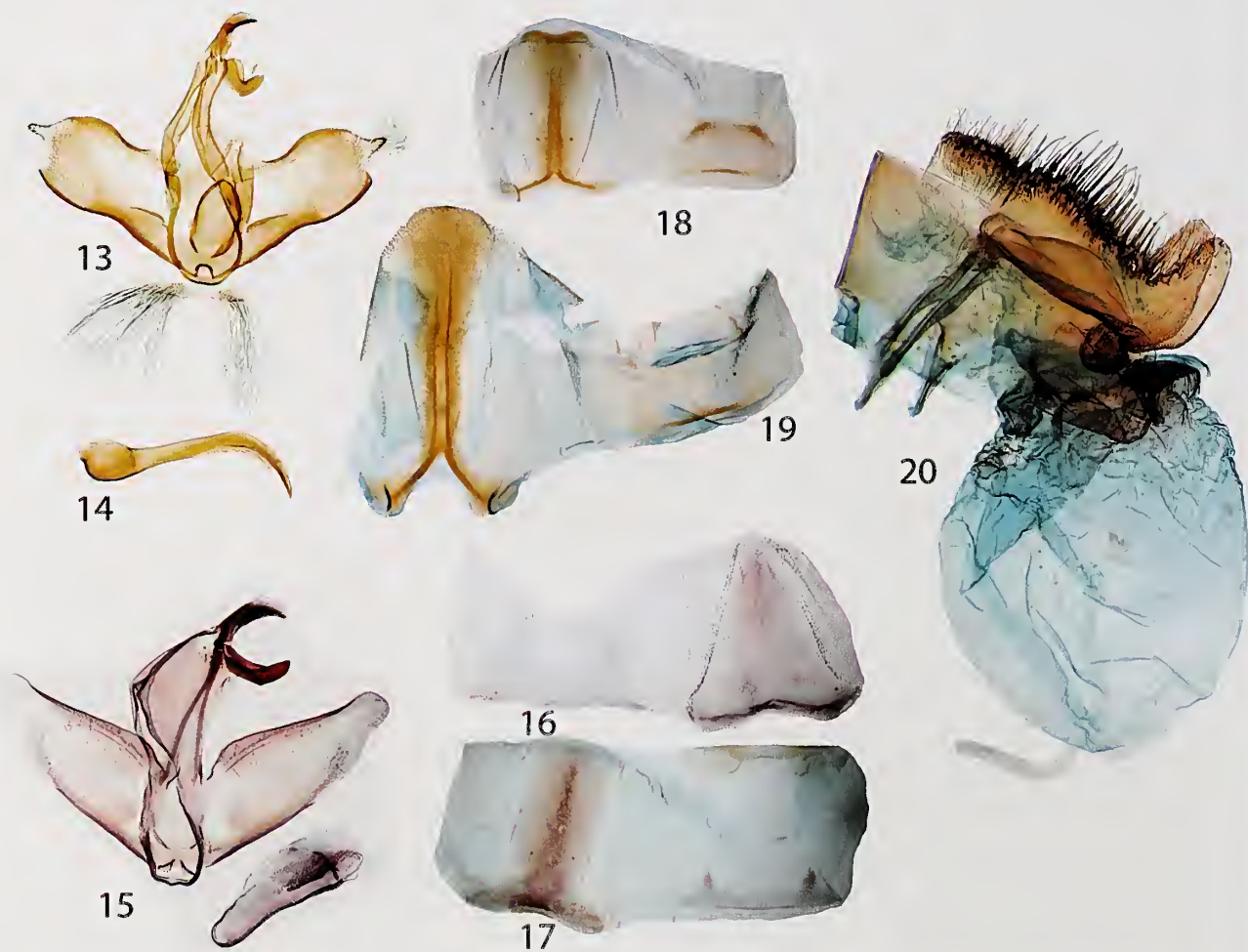
Figs 10-12. Crambinae spp., female genitalia, differences among close genera. (10) *Ancyrolomia planicosta* Martin, Tanzania. (11) *Prionotalis balia* (Tams), Tanzania. (12) *Aurotalis cristata* sp. n., paratype, Zimbabwe. Arrow = papillae anales; thick bar = ostium bursae.

white with black spot in middle. Thorax white with black scales. Abdomen yellowish white with anal tuft pure white. Forewing ground colour white with black markings over all surface and brown patches along costa; median fascia wavy, brown with some additional black scales; subterminal fascia broad, wavy, with margins brown, silvery white in middle; postmedian spot silvery white bordered with brown and black; five black submarginal spots; outer margin black from apex to mid-termen; fringe tricolored with basis white, middle black and outer margin silvery white except at termen, completely silvery white. Hindwing grey to white suffused grey in some ♀♀; fringe white. Male sclerotizations of abdominal segment VIII as in Fig. 17. Female abdominal segment VIII with sternite unsclerotized and tergite narrow and laterally more sclerotized.

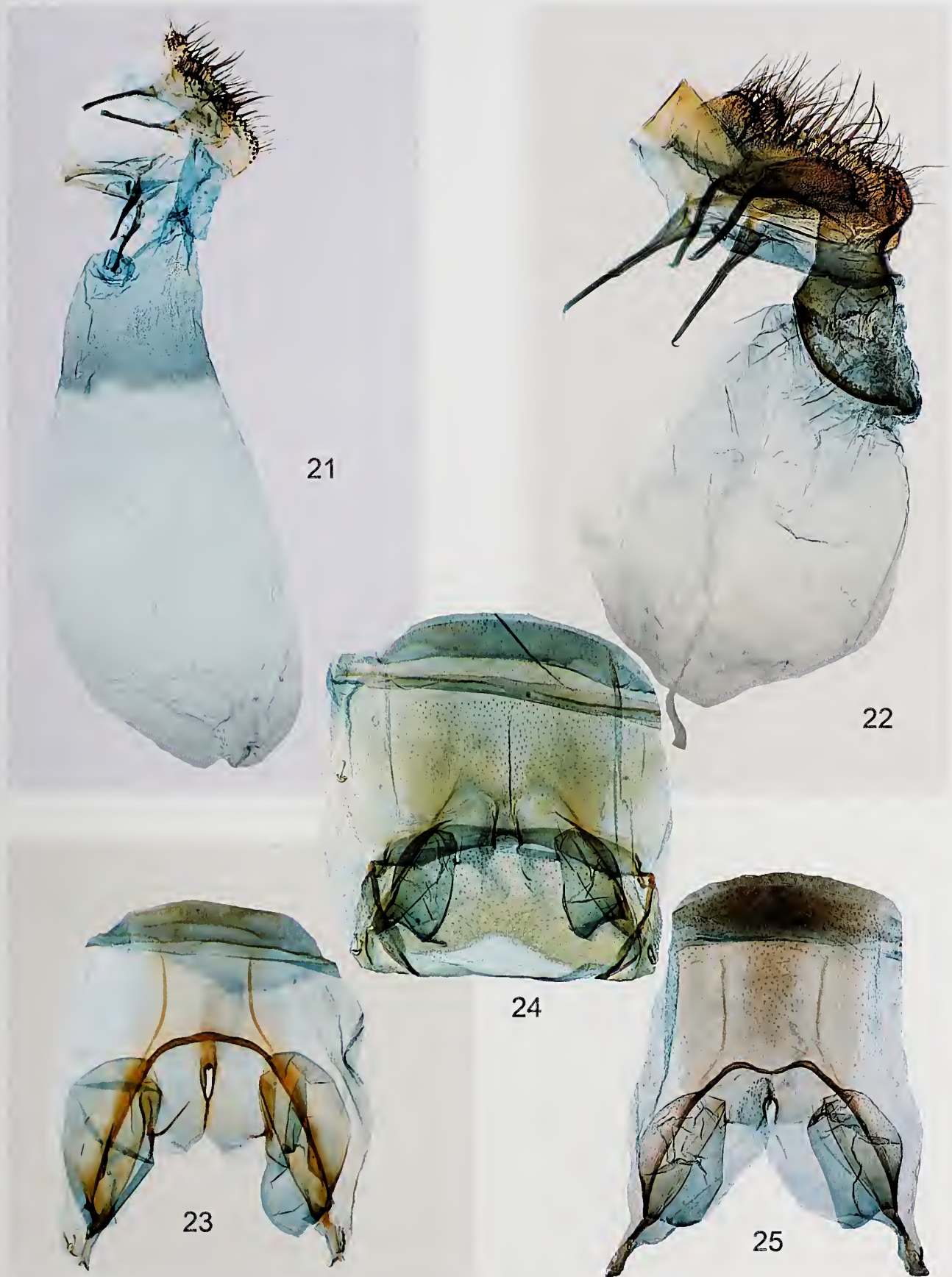
Male genitalia (Fig. 26): Uncus shorter than gnathos,

narrow, with pointed tip. Gnathos broad, straight, with rounded apex and dorsal crest-like sclerotization. Tegumen dorsally fused with uncus, broad membranous area at base of uncus, gnathos and tegumen. Tegumen subtriangular, narrowing toward vinculum. Vinculum narrow, with moderate v-shaped dorsal projection. Juxta subcylindrical, well sclerotized, with finger-like dorsal process. Valva $1.2\times$ length of phallus, with large membranous basal area; cucullus rounded; costa simple, slightly bent; single saccular process small and rounded; harpe with wrinkled sclerotization. Phallus simple, with dorsal bulge in postmedian area; vesica with several thin scobinations.

Female genitalia (Figs 12, 27): Papillae anales broad and well sclerotized, dorsally bulged. Apophyses posteriores $1/3$ longer than apophyses anteriores, well sclerotized. Apophyses anteriores thin. Ductus bursae short and sclerotized. Corpus bursae suboval, broad and spinulate in



Figs 13-20. *Aurotalis* spp., genitalia and male abdominal segment VIII. (13) *A. dionisa* Błeszyński, male genitalia, Namibia. (14) The same, phallus. (15) *A. delicatalis* (Hampson), RSA, phallus extracted on the right. (16) *A. delicatalis*, sclerotizations of abdominal segment VIII. (17) *A. cristata* sp. n., Zimbabwe, sclerotizations of abdominal segment VIII. (18) *A. dionisa* Błeszyński, Namibia, sclerotizations of abdominal segment VIII. (19) *A. nigrisquamalis* (Hampson), Swaziland, sclerotizations of abdominal segment VIII. (20) The same, female genitalia, RSA.



Figs 21-25. *Aurotalis* spp., female genitalia and tympanal organs. (21) *A. delicatalis* (Hampson), female, RSA. (22) *A. dionisa* Błeszyński, female, Namibia. (23) *A. dionisa* Błeszyński, male, Namibia. (24) *A. cristata* sp. n., female paratype, RSA. (25) *A. dicksoni* sp. n., male paratype.

first half. Ductus seminalis opening in first third of corpus bursae.

Distribution: RSA, Zimbabwe.

***Aurotalis delicatalis* (Hampson, 1919)**

Figs 2, 15, 16, 21

Ommatopteryx delicatalis Hampson, 1919a: 535.

Euchromius delicatalis (Hampson, 1919). – Błeszyński & Collins, 1962: 305.

Aurotalis delicatalis (Hampson, 1919). – Schouten, 1992: 197.

Type locality: Malawi.

Diagnosis: The male is similar to *A. cristata* (Fig. 1) in wingspan, but the forewing ground colour is yellow. The metallic silver discoidal lunule, bicolored median fascia in forewings and terminal spots beneath vein 5 distinguish *A. delicatalis* from the other congeners. The male genitalia are most similar to those of *A. similis* (Bassi, 1999: 16-19), but the phallus is without cornutus. The female genitalia are distinguished from

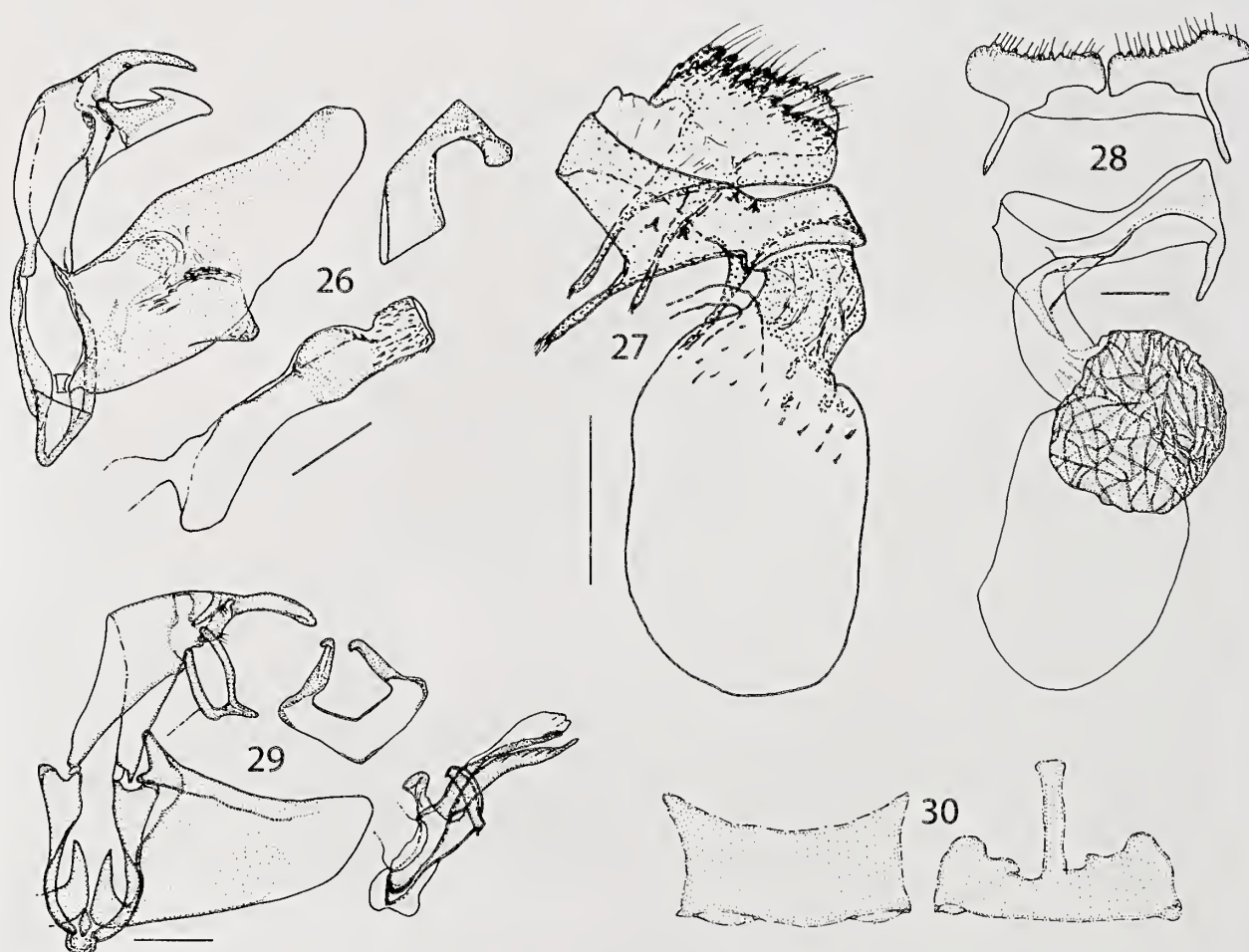
those of other *Aurotalis* by the membranous sterigma and the narrow and membranous ductus bursae.

Additions to original description: Wingspan from 18 to 26 mm, with males smaller. Male sclerotizations of abdominal segment VIII as in Fig. 16. Female abdominal segment VIII lightly sclerotized.

Male genitalia (Fig. 15): Uncus slightly longer than gnathos, apically downcurved, apex blunt. Gnathos tapered. Tegumen subtriangular. Vinculum narrow, without dorsal projection. Juxta flat. Pseudosaccus small. Valva simple, narrowing apically. Phallus stout; vesica with several scobinations.

Female genitalia (Fig. 21): Papillae anales with apical margin straight, ventrally blunt. Both apophyses well developed. Sterigma membranous. Ductus bursae wrinkled, 0.2x length of corpus bursae. Corpus bursae large, suboval, wrinkled and weakly spinulate basally. Ductus ejaculatorius opening in lateral expansion of corpus bursae, proximally at 0.2.

Distribution: Malawi, RSA.



Figs 26-30. *Aurotalis* spp., genitalia and abdominal segment VIII. (26) *A. cristata* sp. n., holotype, on the right juxta and phallus. (27) *A. cristata* sp. n., female paratype, Zimbabwe. (28) *A. argyrastis* (Hampson), holotype. (29) *A. dicksoni* sp. n., male paratype, on the right juxta and phallus. (30) *A. dicksoni* sp. n., sclerotizations of abdominal segment VIII. Scale: 0.5 mm.

Aurotalis dicksoni sp. n.

Figs 3, 25, 29, 30

Holotype: ♀, [RSA, Western Cape, 32°10S, 22° 20'E] Nieuwvelds M[oun]t[ai]ns, 20.XII.1957, CGC Dickson; Holotypus *Aurotalis dicksoni* n. sp. G. Bassi det. 1998. Deposited in TMSA. Not dissected.

Paratype: 1♀, same data as holotype, GS 3551 GB. Deposited in CGB.

Diagnosis: The broad silvery white and brown streaks on the forewings distinguish *A. dicksoni* from the congeners. The male genitalia are closest to those of *A. dionisa* Bleszyński, but the uncus and gnathos are less curved, the valva has no saccular modification, and the juxta is strongly bifurcated.

Etymology: This species is named in honour of the collector, C.G.C. Dickson, who made a very valuable collection of moths in RSA.

Description (Fig. 3): Wingspan 28 mm. Labial palpi 4× longer than widest diameter of eye, with inner side white and outer side ochre brown. Maxillary palpi ochre brown. Frons conical, clearly produced, with one pointed tooth, ochre in middle, elsewhere white. Antenna thickened, brown. Ocelli well developed. Chetosemata present. Head yellow. Patagium ochre yellow. Tegulae ochre brown with apex and inner margin white. Thorax ochre. Forewing with broad silvery white and dark brown streaks embedded in ochre ground colour; submarginal area silvery white with dark brown scales along veins; terminal fascia dark brown; fringe with scales chestnut brown at apex, ochre in middle and white at basis. Hindwing brown; fringe whitish with scales brown at their basis. Legs brown to dark bronze brown. Sclerotizations of abdominal segment VIII as in Fig. 30.

Male genitalia (Fig. 29). Uncus broad, with rounded apex slightly bent downward. Gnathos short and narrow, with rather pointed tip. Tegumen elongated and subtriangular. Vinculum narrow, more enlarged near tegumen, without dorsal projections. Juxta with two narrow lateral arms with curved tips. Pseudosaccus minute. Valva simple, elongated, with rounded cucullus and costal margin more strongly sclerotized. Phallobase with complex system of attachment to juxta. Phallus strongly divided into narrow dorsal part which includes the vesica and ventral pointed and sclerotized arm; vesica without cornuti. Female genitalia unknown.

Distribution: RSA, known only from the type locality.

Remarks: This is a very characteristic species, both in forewing pattern and in male genitalia. It should belong to *Aurotalis* Bleszyński but it seems quite isolated and only the discovery of the female will resolve the correct generic attribution.

Aurotalis dionisa Bleszyński, 1970

Figs 5, 13, 18, 22, 23

Aurotalis dionisa Bleszyński, 1970: 20.

Type locality: Angola.

Diagnosis: This species is similar in size and wing markings to *A. nigrisquamalis* (Hampson) (Fig. 4) and *A. similis* Bassi (Fig. 6) but the forewing ground colour is paler with pale yellow medial and subterminal fasciae, and the hindwings are white. Males also differ by the bipectinate antennae as opposed to only serrate antennae in *A. similis*. In male genitalia the gnathos stout and upcurved, the tapered cucullus of valva and the phallus with bulged phallobase and strongly downcurved distally will readily separate this species from other members of the genus. In the female genitalia, the relatively long ductus bursae, with a semi-circular sclerotization, is diagnostic.

Additions to original description (Fig. 5): Wingspan 20-28 mm, males distinctly smaller. Forewing ground colour thickly dotted with black scales; longitudinal streaks white and blackish brown, expanding between veins after cell; subterminal fascia large, silvery white bordered yellow; fringes golden yellow with short scales tipped black. Hindwing white with veins suffused pale yellow with fringes white. Sclerotizations of male abdominal segment VIII as in Fig. 18.

Male genitalia. Figure 13, from a Namibian specimen, shows the presence of feathery coremata on ventral edge of vinculum, not documented in the original description. Female genitalia. Namibian specimen as in Fig. 22.

Distribution: Angola, Namibia.

Remarks: The adult has not been illustrated before.

Aurotalis hermione Bassi, 1999

Aurotalis hermione Bassi, 1999: 58, 59, figs 5, 11, 12.

Type locality: Zambia.

Diagnosis: The orange median fascia in the forewings, with ill-defined subterminal fascia and dorsum chestnut brown are diagnostic, as well as the vesica with two cornuti, as congeners do not have any cornuti or only one.

Description: Bassi (1999: 58-59).

Male genitalia: Bassi, 1999 (59, figs 11, 12).

Distribution: Zambia.

Remarks: The female is still unknown.

Aurotalis nigrisquamalis (Hampson, 1919)

Figs 4, 9, 19, 20

Conotalis nigrisquamalis Hampson, 1919b: 151.**Type locality:** RSA.

Diagnosis: This species is similar in size and wing markings to *A. dionisa* Bleszyński (Fig. 5) and *A. similis* Bassi (Fig. 6) but the forewing ground colour is yellow with orange medial and subterminal fasciae, and the hindwings are yellow suffused brown with a partial subterminal dark line. In the male genitalia the bifurcate gnathos, the stout valva, and the phallus with two lateral sclerotized bands will readily separate this species from other members of the genus. In the female genitalia, the papillae anales with upturned ventral tip and the ductus bursae short and strongly sclerotized are diagnostic.

Additions to original description: Fresh adult habitus as in Fig. 4. Sclerotizations of abdominal segment VIII as in Fig. 19.

Male genitalia. Whole genitalia as in Fig. 9, with the ventral enlargement close to the uncus tip, bilobed gnathos, and phallus with two lateral and medio-distal sclerotized bands.

Female genitalia (Fig. 20): Papillae anales stout, upturned posteriorly and with globular bottom down bulge. Ductus bursae short, irregularly sclerotized. Corpus bursae suboval, lightly wrinkled. Ductus ejaculatorius opening in small enlargement of proximal third of corpus bursae.

Distribution: Lesotho, RSA, Swaziland, Zimbabwe.

Aurotalis similis Bassi, 1999

Fig. 6

Aurotalis similis Bassi, 1999: 59, figs 6, 16-20.**Type locality:** RSA.

Diagnosis: This species is similar in size and wing markings to *A. nigrisquamalis* (Hampson) and *A. dionisa* Bleszyński, but the forewing ground colour is darker with narrow, orange, median and subterminal fasciae, and the hindwings are white suffused brown. In male genitalia, the phallus with a single blunt cornutus will separate this species from other members of the genus. In female genitalia, the ductus bursae funnel-shaped and lightly sclerotized only near corpus bursae is diagnostic.

Additions to original description: Fresh habitus image as in Fig. 6.

Distribution: Lesotho, Namibia, RSA, Zimbabwe.

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The type specimens of Orthoptera (Insecta) species described by Ignacio Bolívar and deposited in the Muséum d'histoire naturelle de Genève

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Abstract: Definite or probable type specimens of 60 species of Orthoptera described by Ignacio Bolívar have been identified in the collections of the Muséum d'histoire naturelle de Genève. The species are listed alphabetically by suborder and family, and the valid combination is given. Information about the label data and condition of primary type specimens is provided.

Keywords: Acrididae - Pamphigidae - Pyrgomorphidae - Tetrigidae - Gryllidae - Tettigoniidae.

INTRODUCTION

Ignacio Bolívar y Urrutia (1850-1944) was one of the great entomologists of his generation, and also highly influential in the development of Spanish and Mexican education policy. Born in Madrid, Bolívar went into exile in Mexico in 1939 after having taken a high profile role in education policy under the Republican regime. He continued his work in Mexico, founding the Association of Spanish University Lecturers in Exile and the journal *Ciencia*.

Bolívar published numerous books and monographs and described more than a thousand species, almost all of them in the Orthoptera. From early in his career he established links with some of the leading European orthopterists including Carl Brunner von Wattenwyl and Henri de Saussure, and included material from their collections, as well as specimens held by the main European museums, in his studies.

There are several sources of Bolívar type specimens in the Muséum d'histoire naturelle de Genève (MHNG): there was an exchange of specimens in 1879 (accession number 602/42 "Orthoptères; 37; piqué; Espagne, échange = Mr Bolívar"); a number of specimens were lent by Saussure while Bolívar was preparing his monograph on the Tetrigidae (Bolívar, 1887); a number of specimens were studied by Bolívar in around 1908 (Bolívar, 1909); specimens returned to Anton Schulthess having been studied by Bolívar (Bolívar, 1925) and subsequently given to Adolf Nadig who in turn left his collection to the MHNG (Schwendinger & Lienhard, 2001); and a series of specimens collected by Lajos Biro in New Guinea, which were given or exchanged by the Hungarian Natural History Museum (the species concerned have

identification labels in a distinctive handwriting, one of which states that they are "cotypes ex Mus. Hung").

It is known that Bolívar exchanged other specimens with Saussure and Jean Carl (curator of arthropods at the MHNG from 1900 to 1944, and an active orthopterist), as well as providing descriptions of specimens. Bolívar also described species based on specimens Saussure had given to Brunner von Wattenwyl, probably without having seen the rest of the series retained by Saussure, meaning that the series in the MHNG, whilst of the same provenance, are probably not types (D. K. McE. Kevan, *in lit.*).

Since the majority of type specimens in the MHNG were not labelled as such in the 19th and early 20th century, types of other species may be present that can no longer be recognised.

A partial type catalogue of Bolívar's species has been published (Paris, 1994), but it does not cover all of the groups studied by Bolívar, and details of specimens in museums other than the Museo Nacional de Ciencias Naturales in Madrid (MNMS) are incomplete.

ARRANGEMENT AND FORMAT

The species are listed alphabetically by suborder and family. The format for each is:

specific epithet Author, publication: page [*Original generic placement*].

Provenance as given in the original description. Number and kind of type specimens.

Specimen: "Label data" [format of label]. Following the recommendations of Ohl & Oswald (2004) the condition of each primary type specimen is noted. Other comments. Location of material in the MHNG Orthoptera collection.

Currently valid combination following Eades *et al.* (2015).

The following abbreviations are used in the list.

ANSP Academy of Natural Sciences of Philadelphia
MHNG Muséum d'histoire naturelle de Genève
MNMS Museo Nacional de Ciencias Naturales, Madrid
NHMW Naturhistorisches Museum Wien
OSF Orthoptera Species File (Eades *et al.*, 2015)

CATALOGUE

Caelifera

Acrididae

carli Bolívar, 1914: 47 [*Oxyaedia*].

Africa oriental alemana, Carl, Allaud y Jeannel. More than one ♂ and ♀.

Three ♂ syntypes and four ♀ syntypes. A ♂ with labels: "Bukoba, Afrique orient. allemande, Dr J. Carl" [printed on white paper]; "Odontomelis Carli Bol." [handwritten on pink paper]; "Syntypus" [printed on red paper]. Most of both antennae are missing. A ♂ with labels: "Busu-Hill, Busoga Uganda, Dr J. Carl" [printed on white paper]; "Odontomelis Carli Bol." [handwritten on pink paper]; "Syntypus" [printed on red paper]. The right antenna and right hind leg are missing. The left hind leg, which lacks two tarsal segments, is detached and secured through the femur on the original pin. A ♂ with labels: "Njargenie, Ruanda central, Dr J. Carl" [printed on white paper]; "Odontomelis Carli Bol." [handwritten on pink paper]; "Syntypus" [printed on red paper]. Most of both antennae, two tarsal segments of the right middle leg and both of the hind legs are lost. The front legs, both lacking two tarsal segments, are detached and glued to a card mount on the original pin. A ♀ with labels: "Kagera, Ruanda orientale, Dr J. Carl" [printed on white paper]; "Odontomelis Carli Bol." [handwritten on pink paper]; "Syntypus" [printed on red paper]. The tarsi of the left front leg and the claws of the right hind leg are missing. The specimen is coming apart between the meso- and meta-thorax where the pin is inserted. A ♀ with labels: "Kagera, Ruanda orientale, Dr J. Carl" [printed on white paper]; "Odontomelis Carli Bol." [handwritten on pink paper]; "Syntypus" [printed on red paper]. The left antenna is missing. A ♀ with labels: "Sultanat Jhangiro, Distr. Bukoba, Dr J. Carl" [printed on white paper]; "Odontomelis Carli Bol." [handwritten (by Bolívar?) on white paper]; "Syntypus" [printed on red paper]. The right middle leg and both hind legs are missing. A ♀ with labels: "Busu-Hill, Busoga Uganda, Dr J. Carl" [printed on white paper]; "Odontomelis Carli Bol." [handwritten on pink paper]; "Syntypus" [printed on red paper]. The left hind leg, which lacks the last tarsal segment, is detached and glued to a card mount on the original pin. There is a specimen in the MNMS which is referred to as

the holotype on OSF, but there is no such designation in the original description. Box U9.

Oxyaedia carli Bolívar, 1914.

mlokoziejewitzcki Bolívar, 1884: cv-cvi [*Pachytylus*].

Tiflis, leg. Mlokoziejewitzck. Unspecified number of ♂ and ♀.

Lectotype ♂, designated by Ritchie (1981: 94), with labels: "Pachyt. (Oedal.) Mlokoziejewitzci [sic], Boliv. Tiflis, Bolívar" [handwritten on white paper]; "Oedaleus mlokozevitki [sic] Boliv." [handwritten on blue paper]; "Pachytylus (Oedaleus) mlokoziejewitzcki Bol., 1884, J. M. Ritchie, det 1977, LECTOTYPE ♂" [typewritten on white card with "J. M. Ritchie, det. 19" printed]; "Oedaleus senegalensis (Krauss, 1877), J. M. Ritchie det. 1976" [printed on white card]; "LECTOTYPUS" [printed on a disk of white card with a printed purple border]. Specimen set with wings spread. Both antennae and two tarsal segments of both middle legs are lost. There is also a ♀ specimen labelled as a paralectotype. Box V10.

A junior synonym of *Oedaleus senegalensis* (Krauss, 1877).

Pamphigidae

cucullatus Bolívar, 1878: 432-433 [*Eunapius*].

Aranjuez' (Lopez Seoane). Unspecified number of ♂ and ♀.

One possible syntype. A ♀ with labels: "Carthagène, Espagne, M^r Bolivar" [handwritten on lined white card with "Espagne" printed]; "Pamphigus cucullatus Bol. Type! Carthagène" [handwritten on white paper]; "93" [printed on a square of white paper]; "HOLOTYPUS" [handwritten by Harz on white card with hand coloured red border], "Type series mixed: possible syntype. Hollier 2014" [handwritten on red paper]. The last tarsal segment of the left front leg, the entire left middle leg and two tarsal segments of both hind legs are lost. The writing on the identification label indicating that the specimen is a type is similar to Bolívar's, but it seems unlikely that the specimen is part of the type series as currently understood. This specimen is presumably the neotype referred to on OSF, although Harz (1975:121) did not designate a neotype but merely stated the type depository. Box Y5.

Eumigus cucullatus (Bolívar, 1878).

deceptoria Bolívar, 1878: 431, pl. 4, fig. 5 [*Pamphagus*]. Burgos, leg. Sanz de Diego. Unspecified number of ♂ and ♀.

Among the specimens placed under this name in the MHNG collection are four ♂ and two ♀ from the type locality which had been exchanged with Bolívar, and which may be paralectotypes. The ♂ lectotype, designated by Llorente del Moral & Presa (1983: 286), is in the MNMS. Box Y6.

Acinipe deceptoria (Bolívar, 1878).

festiva Bolívar in Saussure, 1884: 231-232 [*Eremobia*]. Persia (coll. Brunner); Caucasus, Georgia. Unspecified number of ♂ and ♀.

One ♀ syntype with labels: “*Eremobia festiva* Type Sauss. Georgie, Perse” [handwritten on yellow paper]; “Er. festiva Bol.” [handwritten on a strip of blue paper]; “Syntypus” [printed on red paper]. Specimen set with wings spread. Both antennae, the tarsi of the left front leg and the tarsi of the right middle leg are missing. The right hind leg has been reattached with glue. The abdomen has been eviscerated and stuffed, presumable at the time of capture. This species is accredited to Saussure on OSF, but to Bolívar in the original publication. Box W2.

Eremopeza festiva (Bolívar, 1884).

Pyrgomorphidae

capensis Bolívar, 1904: 452, 455-456 [*Pyrgomorpha*].

Cabo de Buena Esperanza (Peringuey). One ♀.

Holotype ♀ with labels: “Cap b Esp. Peringuey” [printed on pink paper]; “Pyrgom. capensis Sss. ♀” [handwritten on red paper]; “TYPE Det. D.K.McE. Kevan, 19560” [printed on white card with “TYPE” and “60” handwritten]; “Holotypus” [printed on red card]. Specimen set with right wings spread and left wings folded. The left antenna and the claws of the right hind leg are missing. Box X5.

A junior synonym of *Tanitella prasina* (Karsch, 1888).

inaequalipennis Bolívar 1904: 452-453 [*Pyrgomorpha*].

Desconozco la procedencia. Unspecified number of ♂.

Holotype ♂ with labels: “Kulu 6755/1” [“Kulu” handwritten and numerals printed on a square of white card]; “1530” [handwritten on a square of white card]; “1530” [handwritten on a square of white card]; “inaequalipennis” [handwritten on white card]; “Pyrgomorpha inaequalipennis Sauss. Ind. or.” [handwritten on yellow paper]; “Pyrgomorpha inaequalipennis Bol., HOLOTYPE, Det. D.K.McE. Kevan, 1969” [handwritten on white card with “Det. D.K.McE. Kevan, 19” printed]; “Holotypus” [printed on a disk of white card with a printed red margin]. Specimens set with wings spread. The end of the right antenna, the entire left antenna, the last tarsal segment of the right front leg, the entire left front leg, left middle leg and right middle leg are lost. The hind legs have been reattached with glue, the right lacks the claws. There are two other ♂ and a ♀ with the Kulu label and it is possible that at least some of these were also seen by Bolívar; if this is the case the specimen labelled as holotype can be regarded as the lectotype (designated inadvertently by Kevan, 1970: 851 when he referred to it as the holotype without further comment). Box X5.

Pyrgomorpha inaequalipennis Bolívar, 1904.

insularis Bolívar, 1905: 113, 114-115 [*Tagasta*].

Lombok, 4, 1896, Sapit 2.000 Mai-Juni 1896 (Fruhstorfer). More than one ♂.

One ♂, possibly a syntype, with labels: “Lombok, Sapit 2000”, Mai-Juni 1896, H. Fruhstorfer” [printed on white card]; “*Tagasta insularis* Bol.” [handwritten on yellow paper]; “Possible syntype? Hollier 2014” [handwritten on red paper]. Specimen set with left forewing spread, other wings folded. The left antenna, the claws of the right front leg and the last tarsal segment of the left hind leg are missing. Although this specimen is from the same series as the specimens used for the description, it is possible that Fruhstorfer sold part of his material to the MHNG without it having been seen by Bolívar, meaning that this specimen would not be a syntype. Box X4.

Tagasta insularis Bolívar, 1905.

peringueyi Bolívar, 1904: 442-443 [*Plerisca*].

Cap. B. Esp. Museo de Ginebra. Unspecified number of ♀.

One ♀ syntype with labels: “Cap b Esp.” [printed on pink paper]; “Pyrgom. Peringuey Sss. ♀” [handwritten on red paper]; “Plerisea peringueyi I. Bol., V. M. Dirsh det. 1959, Type!” [handwritten on white card with “V. M. Dirsh det. 195” printed]; “Syntypus” [printed on red paper]. The last tarsal segment of the left front leg, right middle leg and left hind leg, and the entire right hind leg are missing. Box X5.

Plerisca peringueyi Bolívar, 1904.

scudderi Bolívar, 1884: 447 [*Prospheana*].

Guatemala, coll. Scudder. Unspecified number of ♂ and ♀.

The MHNG has a pair of specimens under this name, both from Guatemala and apparently labelled in Bolívar’s handwriting, which may be paralectotypes. The lectotype, designated by Rehn (1953: 102), is in the ANSP. Box X7.

Prospheana scudderi Bolívar, 1884.

Tetrigidae

africana Bolívar, 1909: 399-400 [*Mazarredia* (sic)].

Camerun. Unspecified number of ♂.

One ♂ syntype with labels: “CAMERUN” [printed on a strip of pink paper]; “Mazarredia africana Bol.” [handwritten on white paper]; “Syntypus” [printed on red paper]. The left antenna, the tarsi of the left front leg and right middle leg and the last tarsal segment of the right hind leg are missing. Box Q4.

Mazarredia africana Bolívar, 1909.

apicalis Bolívar, 1909: 394 [*Kraengia*].

S. Celebes, Bua-Kraeng, 5000. Fruhstorfer. Unspecified number of ♂.

Two ♂ syntypes. A ♂ with labels: “S. Celebes, Bua-Kraeng, 5000, Febr. 1896 H. Fruhstorfer” [printed on white card]; “*Kraengia apicalis* Bol.” [handwritten on white paper]; “Syntypus” [printed on red paper]. The

right front and middle legs are missing. A ♂ with labels: "S. Celebes, Bua-Kraeng, 5000, Febr. 1896 H. Fruhstorfer" [printed on white card]; "Kraengia apicalis Bol." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. The right hind leg is missing. Box Q1.

Kraengia apicalis Bolívar, 1909.

bedoti Bolívar, 1909: 395-396 [*Eugavialidium*].

Java occident, Pengalengan, 4000, 1893, Fruhstorfer. Unspecified number of ♂.

One ♂ syntype with labels: "Java occident. Pengalengan, 4000' 1893, H. Fruhstorfer" [printed on white card]; "Eugavolid. Bedoti Bol." [handwritten on white paper]; "Syntypus" [printed on red paper]. Both antennae and the right hind leg are missing. Box Q2.

Falconius bedoti (Bolívar, 1909).

biolleyi Bolívar, 1909: 401 [*Scabritettix* (sic)].

Cariblana, P. Biolley. Unspecified number of ♀.

One ♀ syntype with labels: "Cariblanca, 600m, P. Biolley" [handwritten on white paper with the top right corner ripped off]; "Syntypus S. biolleyi Bol." [handwritten on red paper with "Syntypus" printed]. Both antennae, both front legs and the last tarsal segment of the right hind leg are lost. Box Q4.

Scabrotettix biolleyi Bolívar, 1909.

carli Bolívar, 1909: 397 [*Systolederus*].

Lombok Sapit 2.000' Mai-Juin 1896. H. Fruhstorfer. Unspecified number of ♂ and ♀.

Ten ♂ syntypes and five ♀ syntypes. A ♂ with labels: "Lombok Sapit 2000', Mai-Juni 1896, H. Fruhstorfer" [printed on white card]; "Systolederus Carli Bol." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. Specimen set with wings folded. Both antennae, the right middle leg and the tibia and tarsi of the left hind leg are missing. A ♂ with labels: "Lombok Sapit 2000', Mai-Juni 1896, H. Fruhstorfer" [printed on white card]; "Systolederus Carli Bol." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. Specimen set with wings folded. Both antennae, the right front and middle legs, the tibia and tarsi of the left front leg and part of the last tarsal segment of the right hind leg are lost. A ♂ with labels: "Lombok Sapit 2000', Mai-Juni 1896, H. Fruhstorfer" [printed on white card]; "Systolederus Carli Bol." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. Specimen set with wings folded. Both antennae, part of the tibia and the tarsi of the left middle leg and the entire right hind leg are missing. A ♂ with labels: "Lombok Sapit 2000', Mai-Juni 1896, H. Fruhstorfer" [printed on white card]; "Systolederus Carli Bol." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. Specimen set with wings folded. A ♂ with labels: "Lombok Sapit 2000', Mai-Juni 1896, H. Fruhstorfer" [printed on white card]; "Systolederus Carli Bol." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. Specimen set with wings folded.

The right antenna, the tarsi of both front legs, the entire right middle and hind legs and the tibia and tarsi of the left hind leg are lost. A ♂ with labels: "Lombok Sapit 2000', Mai-Juni 1896, H. Fruhstorfer" [printed on white card]; "Systolederus Carli Bol." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. Specimen set with wings folded. The right antenna, right front leg, both middle legs and both hind legs are lost. A ♂ with labels: "Lombok Sapit 2000', Mai-Juni 1896, H. Fruhstorfer" [printed on white card]; "Systolederus Carli Bol." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. Specimen set with wings roughly folded. The right antenna and left hind leg are missing. A ♂ with labels: "Lombok Sapit 2000', Mai-Juni 1896, H. Fruhstorfer" [printed on white card]; "Systolederus Carli Bol." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. Specimen set with wings folded. The left antenna, the tarsi of the right middle leg and the entire left hind leg are lost. A ♂ with labels: "Lombok Sapit 2000', Mai-Juni 1896, H. Fruhstorfer" [printed on white card]; "Systolederus Carli Bol." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. Specimen set with wings folded. The tarsi of the left middle leg and all of both hind legs are missing. A ♂ with labels: "Lombok Sapit 2000', Mai-Juni 1896, H. Fruhstorfer" [printed on white card]; "Systolederus Carli Bol." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. Specimen set with wings folded. The right antenna, the tarsi of both front legs, part of the tibia and the tarsi of the right middle leg and all of the left middle leg and both hind legs are lost. A ♀ with labels: "Lombok Sapit 2000', Mai-Juni 1896, H. Fruhstorfer" [printed on white card]; "Systolederus Carli Bol." [handwritten on white paper]; "Systolederus Carli Bol." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. Specimen set with wings folded. The right antenna and the tarsi of the right front and middle legs are lost. A ♀ with labels: "Lombok Sapit 2000', Mai-Juni 1896, H. Fruhstorfer" [printed on white card]; "Systolederus Carli Bol." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. Specimen set with wings folded. Part of the tibia and the tarsi of the right middle leg and the entire right hind leg are missing. A ♀ with labels: "Lombok Sapit 2000', Mai-Juni 1896, H. Fruhstorfer" [printed on white card]; "Systolederus Carli Bol." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. Specimen set with wings folded. Both antennae are lost. A ♀ with labels: "Lombok Sapit 2000', Mai-Juni 1896, H. Fruhstorfer" [printed on white card]; "Systolederus Carli Bol." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. Specimen set with wings folded. Both antennae and the tibia and tarsi of the left hind leg are lost. A ♀ with labels: "Lombok Sapit 2000', Mai-Juni 1896, H. Fruhstorfer" [printed on white card]; "Systolederus Carli Bol." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. Specimen set with wings folded. Both antennae and the left

hind leg are lost. The specimen is nearly broken in two where the pro- and meta-thorax join. Box Q3.
Systolederus carli Bolívar, 1909.

dromadaria Bolívar, 1909: 401 [*Xistrella*].

Sikkin, L. M. Unspecified number of ♂ and ♀.

One ♂ syntype and one ♀ syntype. A ♂ with labels: “*Xistrella dromadaria* Bol.” [handwritten on yellow paper]; “Syntypus” [printed on red paper]. Specimen set with wings folded. Both antennae and all the legs are missing. A ♀ with labels: “Sikkin, L. M.” [handwritten on a disk of white paper]; “*Xistrella dromadaria* Bol.” [handwritten on white paper]; “Syntypus” printed on red paper]. Both antennae, both front legs and the left middle leg are lost as are the tarsi of the right middle leg and both hind legs. The unusually thick pins used to mount these specimens indicate their common provenance. Box Q4.
Xistrella dromadaria Bolívar, 1909.

feae Bolívar, 1909: 396 [*Eugavialidium*].

Carin Cheba. Unspecified number of ♂ and ♀.

Lectotype ♀, designated inadvertently by Günther (1938a: 418) who referred to the specimen as the holotype (Paris, 1994), with labels: “Carin Cheba, 900-1100m, L. Fea, V-XI 88” [printed on white card]; “*Gavialidium Feae* Bol. [handwritten on white paper]; “Dr. K. Günther det. 1938: *Falconius inaequalis* Br. ugl. mit Typus” [handwritten on white card with “Dr. K. Günther det. 1938:” printed]; “Syntypus *E. feae* Bolívar 1909” [handwritten on red paper]. Specimen set with wings roughly folded. The right antenna, two tarsal segments of the left front leg and two tarsal segments of both hind legs are lost. Box Q2.

A junior synonym of *Falconius inaequalis* (Brunner von Wattenwyl, 1893).

flavopictum Bolívar, 1909: 394-395 [*Eugavialidium*].

Calcutta. Two ♀.

Lectotype ♀, designated inadvertently by Günther (1938a: 373) who referred to the specimen as the holotype (Paris, 1994), with labels: “Calcutta F. S.” [handwritten on a disk of white card]; “1097” [handwritten on white card]; “*Gavialidium flavopictus* Bol.” [handwritten on white paper]; “Lectotypus” [printed on red card]. Both antennae, the right front leg, the tarsi of the left front leg and both middle legs, and both hind legs are missing. The second ♀, with an identical data label, has been placed under *I. angulata* (Hancock, 1915), presumably by K. Günther. Box Q2.

Indoscelimena flavopicta (Bolívar, 1909).

freygessneri Bolívar, 1887: 276 [*Paratettix*].

Cuba (Frey-Gessner, Brunner, Gundlach). Unspecified number of ♂ and ♀.

Two ♂ syntypes and two ♀ syntypes. A ♂ with labels: “Cuba, M. H. de Saussure” [handwritten on white paper]; “118 *Tettix* Frey-Gessneri Boliv. Type.” [handwritten on

white paper]; “Parat. Frey-Gessneri Boliv.” [handwritten on green paper], “Syntypus” [printed on red paper]. Specimen set with wings folded. The right antenna is missing. A ♂ with labels: “Cuba, M. H. de Saussure” [handwritten on white paper]; “Parat. Frey-Gessneri Boliv.” [handwritten on green paper], “Syntypus” [printed on red paper]. Specimen set with wings folded. The left antenna, the elaws of the left middle leg and the entire left hind leg are missing. A ♀ with labels: “Cuba, M. H. de Saussure” [handwritten on white paper]; “Parat. Frey-Gessneri Boliv.” [handwritten on green paper], “Syntypus” [printed on red paper]. Specimen set with wings folded. Both antennae are missing. A ♀ with labels: “Cuba, M. H. de Saussure” [handwritten on white paper]; “Parat. Frey-Gessneri Boliv.” [handwritten on green paper], “Syntypus” [printed on red paper]. Specimen set with wings folded. Both antennae, both front legs and the right hind leg are lost. According to Paris (1994) there is another syntype in the MNMS. Box Q6.

Paratettix freygessneri Bolívar, 1887.

indotata Bolívar, 1909: 398 [*Mazarredia*].

Loc.? Probably one ♀.

Lectotype ♀, designated inadvertently by Günther (1939: 59) who referred to the specimen as the holotype (Paris, 1994), with labels: “Palanis [?] 7509/1” [locality handwritten illegibly, numerals printed on white card]; “*Mazarredia indotata* Bol.” [handwritten on white paper]; “Dr K. Günther det. 1938: *Mazarredia sculpta* Bol. vgl. mit Holotypus” [handwritten on white card with “Dr K. Günther det. 1938:” printed]; “Lectotypus” [printed on red card]. Both antennae, the left front leg, the tarsi of the right front leg and left middle leg and the last tarsal segment of both hind legs are lost. The locality label is in the same style as those of *Pyrgomorpha inaequalipennis* (see above) so the specimen is probably from northern India. Box Q4.

A junior synonym of *Bolivaritettix sculpta* (Bolívar, 1887).

insularis Bolívar, 1887: 329 [*Mazarredia*].

Ceylon (ma collection, eommuniquée par M. H. de Saussure). Unspecified number of ♂.

There are four specimens collected by Humbert in Sri Lanka under this name in the MHNG. One ♂ has the label “116 *Mazarresia insularis* Bol. n. sp. Bolívar type” [handwritten on white paper] and is clearly a paralectotype; it is not clear whether Bolívar saw the others. The ♂ lectotype, designated by Paris (1994: 241) is in the MNMS. Box Q4.

A junior synonym of *Criotettix subulatus* Bolívar, 1887.

javanica Bolívar, 1909: 398 [*Mazarredia*].

Java. Unspecified number of ♂ and ♀.

Lectotype ♀, designated inadvertently by Günther (1939: 71) who referred to the specimen as the holotype (Paris, 1994), with labels: “621 19 JAVA” [printed on yellow

with labels: "Lombok, Sapit 2000", Mai Juni 1896, H. Fruhstorfer" [printed on white card]; "Criotettix lombokensis Bol." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. Specimen set with wings folded. Both antennae, the right front and middle legs and two tarsal segments of the right hind leg are missing. A ♀ with labels: "Lombok, Sapit 2000", Mai Juni 1896, H. Fruhstorfer" [printed on white card]; "Criotettix lombokensis Bol." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. Specimen set with wings folded. The right antenna and left hind leg are lost. Paris (1994) stated that Günther (1938b: 181) had inadvertently designated a lectotype by referring to a ♀ specimen as the "typus", but since there is no indication of which specimen Günther was referring to the designation is not valid. Box Q3.

Eucriotettix oculatus lombokensis (Bolívar, 1909).

nigellus Bolívar, 1887: 225 [*Criotettix*].

Gabon (Musée de Genève et ma coll.) More than one ♂. The MHNG collection has a ♂ and two ♀ specimens under this name. The locality on the labels affixed to the specimens is "Camerun", although the species name label in the insect box has "Gabon" handwritten in the lower left corner. The ♂ has a label reading "Criotettix nigellus Bol. Camerun" in a handwriting similar to those of other Bolívar labels, and may be a paralectotype, although it is more likely that the series was identified by Bolívar at a later date than that he mistook the provenance of his types. The ♂ lectotype, designated by Paris (1994: 244), is in the MNMS. Box Q3.

Afrocriotettix nigellus (Bolívar, 1887).

oculatus Bolívar, 1898: 71-72 [*Criotettix*].

Sumatra: Si-Rambé, Décembre 1890-Mars 1891, E. Modigliani. Je possédais déjà cette espèce de Java (Fruhstorfer). Unspecified number of ♂ and ♀.

The MHNG has eight specimens collected by Fruhstorfer in Java under this name, one of which has an identification label similar to those of some of the Bolívar type specimens in the collection. It is therefore possible that this specimen and some or all of the others are syntypes, but it is more likely that Bolívar made the identification when studying material from the MHNG after the publication of the original description. Box Q3.

Eucriotettix oculatus oculatus (Bolívar, 1898)

ophthalmica Bolívar, 1909: 399 [*Mazarredia*].

Sibs S. E. P. Unspecified number of ♂ and ♀? [Description says ♀ and the measurements ♂]

Lectotype ♂, designated inadvertently by Günther (1939: 152) who referred to the specimen as the holotype (Paris, 1994), with labels: "Sibs, S. E. P." [printed on white card]; "673" [handwritten on white card]; "Mazarredia ophthalmica Bol." [handwritten on white paper]; "Typus" [printed on red card]. Specimen set with wings folded. Both antennae, the last tarsal segment of the right front leg, the

entire right middle and hind legs and the claws of the left hind leg are missing. Box Q4.

Xistrella ophthalmica (Bolívar, 1909).

peruvianus Bolívar, 1887: 272 [*Paratettix*].

Pumamarca (Pérou) Musée de Varsovie. Unspecified number of ♂ and ♀.

One syntype with labels: "PERU CENT, 105" [printed on white paper with numerals handwritten]; "Paratettix peruvianus Bolívar det." [handwritten on white paper]; "Allotettix peruvianus Bol." [handwritten on green paper]; "Syntypus" [printed on red paper]. Specimen set with wings folded. Both antennae, the right front leg, the tarsi of the left front leg, both middle legs and the left hind leg, and two tarsal segments of the right hind leg are missing. Box Q5.

Allotettix peruvianus (Bolívar, 1887)

problematicus Bolívar, 1909: 402-403 [*Coptotettix*].

Haut Assam. Unspecified number of ♂ and ♀.

One syntype with labels: "Upper Assam, 1235/9" [handwritten on white card with "1235" printed]; "Coptotettix problematicus Bol." [handwritten on white card]; "Syntypus" [printed on red paper]. Specimen set with wings folded. Both antennae and the last tarsal segment of the left hind leg are missing. Box Q5.

Hyboella problematica (Bolívar, 1909).

saussurei Bolívar, 1887: 203-205; figure 5 [*Chloriphyllum*].

Cuba (coll. Gundlach et Musée de Genève). Unspecified number of ♀.

Two ♀ syntypes. A ♀ with labels: "Cuba M. H. de Saussure" [handwritten on white paper]; "62 Chloriphyllum Saussurei Boliv., Boliv. det." [handwritten on white paper]; "Chloriphyllum saussurei Bol." [handwritten on green paper]; "Syntypus" [printed on red paper]. The last tarsal segment of the left hind leg and the entire right hind leg are missing. A ♀ with labels: "Cuba M. H. de Saussure" [handwritten on white paper]; "Chloriphyllum saussurei Bol." [handwritten on green paper]; "Syntypus" [printed on red paper]. The left antenna and left hind leg are missing. Box Q1.

Chloriphyllum saussurei Bolívar, 1887.

saussurei Bolívar, 1909: 402 [*Nomatettix*].

Santa Cruz, Mojoapan près d'Orizaba. Région des pins. One ♂.

Holotype ♂ with labels: "Sta Cruz, Mojoapan près Orizaba, région des pins" [handwritten on white card]; "Nomatettix Saussurei Bol." [handwritten on white paper]; "Nomatettix Saussurei Bol." [handwritten on green paper]; "Holotypus" [printed on red card]. Both antennae, the claws of the right hind leg and the entire left hind leg are missing. Box Q6.

Nomatettix saussurei Bolívar, 1909.

selysi Bolívar, 1887: 306, 307 [*Discotettix*].

Sumatra. Unspecified number of ♂.

One ♂ syntype with labels: "Sumatra, 25 XII 84, Soerian" [handwritten on white card]; "6 Mnesarchus Selysi Bolívar det." [handwritten on white paper]; "Discotettix Selysi Bol." [handwritten on yellow paper]; "Syntypus" [printed on red paper]. Bolívar gave no indication in the original description of where the type material was deposited. Box Q1.

Discotettix selysi Bolívar, 1887.

sikkinensis Bolívar, 1909: 398-399 [*Mazarredia*].

Sikkim. Unspecified number of ♂.

Lectotype ♂, designated inadvertently by Günther (1939: 65) who referred to the specimen as the holotype (Paris, 1994), with labels: "Sikkim, 8999/7" [handwritten on white card with "8999/7" printed, the end of the locality name is smudged, the card is broader at the top than at the bottom]; "Mazarredia sikkinensis Bol." [handwritten on white paper]; "Lectotypus" [printed on red card]. Specimen set with wings folded. Both antennae, the tarsi of both front legs, two tarsal segments of the right middle leg and the entire left hind leg are missing. Box Q4.

Bolivaritettix sikkinensis (Bolívar, 1909).

subulatus Bolívar, 1887: 227 [*Criotettix*].

Indes orientales (ma collection). Reçu de M. H. de Saussure. Unspecified number of ♀.

One ♀ paralectotype. The ♀ lectotype, designated by Paris (1994: 250) is in the MNMS. Box Q3.

Criotettix subulatus Bolívar, 1887.

tricarinatus Bolívar, 1887: 224 [*Criotettix*].

Ceylan (Humbert, Musée de Genève et ma collection). Unspecified number of ♂ and ♀.

Lectotype ♂, designated by Wagan & Kevan (1992: 181), with labels: "41 Criotettix tricarinatus, Bolívar det." [handwritten on white paper]; "Criotettix tricarinatus Bolívar" [handwritten on yellow paper]; "Syntypus" [printed on red paper]. The right antenna, the right middle leg and both hind legs are missing. The lectotype designation refers to "the ♂ in Geneva" but the MHNG collection has a series of seven ♂ and four ♀ collected by Humbert in Sri Lanka. Only one of each sex has a Bolívar identification label however, and the lectotype designation presumably means the ♂ specimen with this label. Box Q3.

Eucriotettix tricarinatus (Bolívar, 1887).

vidali Bolívar, 1887: 227 [*Criotettix*].

Causip Camarines (Philippines) (Mazzaredo, ma coll.). Unspecified number of ♂ and ♀.

One ♂ syntype with labels: "Criotettix Vidali Bolívar, Philippines; Bolívar" [handwritten on yellow paper]; "Syntypus" [printed on red paper]. Specimen set with wings folded. Box Q3.

Criotettix vidali Bolívar, 1887.

Ensifera

Gryllidae

aterrima Bolívar, 1925: 413, 414-416 [*Sciobia* (*Platyblemmus*)].

Tazza (Escalera). ♂ holotype and two ♂ paratypes.

One ♂ paratype. The ♂ holotype and one ♂ paratype are in the MNMS (Paris, 1994). Box Nadig 1012.

A junior synonym of *Sciobia tristis* (Bolívar, 1925).

chevreuxi Bolívar, 1925: 413, 425-427 [*Sciobia* (*Platyblemmus*)].

Maroc: Azrou (Escalera), Ourica (Pallary). ♂ holotype and an unspecified number of ♂ and ♀ paratypes.

One ♂ paratype. The ♂ holotype and 42 paratypes are in the MNMS (Paris, 1994). Box Nadig 1013.

Sciobia chevreuxi Bolívar, 1925.

chopardi parabolica Bolívar, 1925: 409 [*Lissoblemmus* (*Mitroblemmus*)].

Méquinez (Escalera), Azrou (Schulthess & Escalera). Unspecified number of syntypes.

A ♂ syntype with labels: "Marocco, Azrou, 30.2.23, Schulthess" [handwritten on white card]; "15" [handwritten on a strip of white card]; "Mitroblemmus Chopardi Bol. v. parabolicus [sic], type, I. Bol. det." [handwritten on white card]; "Typus" [printed on red card]. Most of both antennae, the claws of the right front leg and the entire left hind leg are missing. There are four further syntypes in the MNMS (Paris, 1994). Box Nadig 1013.

Sciobia chopardi parabolica (Bolívar, 1925).

fragosoi Bolívar, 1885a: 117 [*Gryllomorphus*].

Dos Hermanas (Seville). Unspecified number of ♂.

The single specimen placed under this name in the MHNG has a locality label of a form (white card rectangle with the points of the corners cut off) and handwriting very similar to those of some of the Bolívar lectotypes illustrated on OSF and dissimilar in both senses from the usual MHNG labels. It is therefore possible, if unlikely, that this is a syntype. A ♂ with labels: "Seville Julio" [handwritten on white card]; "Gryllomorphus fragosoi Bol. Seville" [handwritten on white paper]; "Gryllomorphus fragosoi Bol." [handwritten on blue paper]; "Possible syntype? Hollier 2014" [handwritten on red paper]. Two tarsal segments of the right hind leg and the entire left hind leg are missing. Paris (1994) considered the type series lost. Box A19

Petaloptila fragosoi (Bolívar, 1885).

littoreus Bolívar, 1885b: 174 [*Gryllodes*].

Talavera de la Reina. Unspecified number of ♂ and ♀ syntypes.

Five ♂ and one ♀, all possibly syntypes. A ♂ with labels: "Gryllodes littoreus Bol. ♂ Talavera Bolívar" [handwritten on white paper]; "Gryllodes littoreus Boliv." [handwritten on blue paper]; "Possible syntype Hollier

2014" [handwritten on red paper]. Specimen set with wings folded. Most of both antennae are lost. A ♂ with labels: "Gr. littoreus Bol., Talavera Bolivar" [handwritten on white paper]; "Gryllodes littoreus Boliv." [handwritten on blue paper]; "Possible syntype Hollier 2014" [handwritten on red paper]. Specimen set with wings folded. The right hind leg is missing. A ♂ with labels: "Gr. littoreus Bol., Talavera Bolivar" [handwritten on white paper]; "Gryllodes littoreus Boliv." [handwritten on blue paper]; "Possible syntype Hollier 2014" [handwritten on red paper]. Specimen set with wings folded. Most of the left antenna is missing. A ♂ with labels: "Gr. littoreus Bol., Talavera Bolivar" [handwritten on white paper]; "Gryllodes littoreus Boliv." [handwritten on blue paper]; "Possible syntype Hollier 2014" [handwritten on red paper]. Specimen set with wings folded. Most of the right antenna is missing. A ♂ with labels: "Gryllodes littoreus Bol. ♂ Talavera Bolivar" [handwritten on white paper]; "Gryllodes littoreus Boliv." [handwritten on blue paper]; "Eugryllodes littoralis (Bol.) [sic] Det. R. L. Randell, 1963" [handwritten on white card with "Det. R. L. Randell, 19" printed]; "Possible syntype Hollier 2014" [handwritten on red paper]. Specimen set with wings folded. Both antennae and the right hind leg are missing. A ♀ with labels: "Gryllodes littoreus Bol. ♀ Talavera Bolivar" [handwritten on white paper]; "Gryllodes littoreus Boliv." [handwritten on blue paper]; "Possible syntype Hollier 2014" [handwritten on red paper]. The left hind leg is missing. Although it is clear from the original description that Bolívar collected many examples, it is known that he also collected this species at the type locality after the publication of the description (see Holstein & Ingrisch, 2004: 4) and so the specimens cannot be definitely identified as syntypes. There are 11 further syntypes in the MNMS (Paris, 1994). Box A14.

Eugryllodes littoreus (Bolívar, 1885).

schulthessi Bolívar, 1925: 391, 392-393 [*Holoblemmus*]. Maroc: Tazza (Escalera), Fez (Schulthess). ♂ holotype and an unspecified number of ♂ and ♀ paratypes. At least one ♂ paratype. One specimen has the label "Holoblemmus schulthessi Bol., cotype, I. Bol. det." [handwritten on white card]. There are seven other ♂ from Fez collected by Schulthess, two with identification labels written by Bolívar, but without indication of their type status. The ♂ holotype and 23 paratypes are in the MNMS (Paris, 1994). Box Nadig 1011.

Holoblemmus schulthessi Bolívar, 1925.

tristis Bolívar, 1925: 403-404 [*Lissoblemmus* (*Mesoblemmus*)]. Maroc: Tazza (Escalera). ♂ holotype, one ♂ paratype and one ♀ paratype. One ♀ paratype. The ♂ holotype and ♀ paratype are in the MNMS (Paris, 1994). Box Nadig 1011.

Sciobia tristis (Bolívar, 1925).

xauensis Bolívar, 1925: 414, 428-430 [*Sciobia* (*Platyblemmus*)].

Maroc: Bas Xauen (Escalera). ♂ holotype and an unspecified number of ♂ and ♀ paratypes.

One ♂ paratype and one ♀ paratype. The ♂ holotype and 42 paratypes are in the MNMS (Paris, 1994). Box Nadig 1012.

A junior synonym of *Sciobia barbara* (Saussure, 1877).

Tettigoniidae

areolaris Bolívar, 1877: 292-293, pl. 4, fig. 6 [*Ephippiger*].

Granada (Brunner); Albarracín (Zapater); Madrid. Unspecified number of ♂ and ♀.

Amongst the specimens placed under this name in the MHNG are five examples exchanged with Bolívar in 1879, one of which is from one of the type localities and may be a paralectotype. This specimen is paler than the others in the MHNG and more carefully set. Paris (1994) states that a ♀ specimen in the MNMS was inadvertently designated as lectotype when Peinado & Mateos (1986b: 356) referred it as the holotype. Box L4.

Ephippigerida areolaria (Bolívar, 1877).

atrospinosa Bolívar, 1903: 164-165 [*Biroa*].

Sattelberg, Golfe Huon (Biro 1899). Unspecified number of ♂ and ♀.

Two ♂ and two ♀, all possible syntypes. A ♂ with labels: "N. Guinea, Biro 1899." [printed on white card]; "Sattelberg, Huon-Golf" [printed on white card]; "Biroa atrospinosa Bol." [handwritten on white card]; "Possible syntype, Hollier 2014" [handwritten on red paper]. Specimen set with wings folded. A ♂ with labels: "N. Guinea, Biro 1899." [printed on white card]; "Sattelberg, Huon-Golf" [printed on white card]; "Biroa atrospinosa Bol." [handwritten on lilac paper]; "Possible syntype, Hollier 2014" [handwritten on red paper]. Specimen set with wings folded. A ♀ with labels: "N. Guinea, Biro 1899." [printed on white card]; "Sattelberg, Huon-Golf" [printed on white card]; "Biroa atrospinosa Bol." [handwritten on lilac paper]; "Possible syntype, Hollier 2014" [handwritten on red paper]. Specimen set with wings folded. The right front leg is missing. A ♀ with labels: "N. Guinea, Biro 1899." [printed on white card]; "Sattelberg, Huon-Golf" [printed on white card]; "Biroa atrospinosa Bol." [handwritten on lilac paper]; "Possible syntype, Hollier 2014" [handwritten on red paper]. Specimen set with wings folded. There is also one ♂ syntype and one ♀ syntype in the MNMS (Paris, 1994) (images on OSF). Box D1.

Biroa atrospinosa Bolívar, 1903.

biroi Bolívar, 1902: 181-182 [*Aphroptera*].

Friedrich-Wilhelmshafen, Stephansort, Erima, Simbang, Sattelberg (Huon Golf) (Biro). Unspecified number of ♂ and ♀.

Two ♀ syntypes. A ♀ with labels: "N. Guinea, Biro 97." [printed on white card]; "Stephansort, Astrolabe Bai" [printed on white card]; "Aphroptera biroi Bol. 2 ex. ex Mus Hongare." [handwritten on lilac paper]; "Syntypus" [printed on red paper]. Specimen set with wings folded. The last tarsal segment of the left front leg is missing. A ♀ with labels: "N. Guinea, Biro 1899." [printed on white card]; "Sattelberg, Huon-Golf" [printed on white card]; "Aphroptera biroi" [handwritten on white card]; "Syntypus" [printed on red paper]. Specimen set with wings folded. The claws of the left hind leg are missing. There are four ♂ syntypes in the MNMS (Paris, 1994) (images on OSF). Box B11.

Aphroptera biroi Bolívar, 1902.

brunnerii Bolívar, 1877: 272-273, pl. 3, fig. 4 [*Ephippiger*].

Cuenca (Perez); Brunete (Madrid); Madrid (Saenz Hermua); Aranjuez; Escorial. Unspecified number of ♂ and ♀.

Among the specimens placed under this name in the MHNG are five examples that were exchanged with Bolívar in 1879, all from the type localities, that may be paralectotypes. Paris (1994) states that a ♂ specimen in the MNMS was inadvertently designated as lectotype when Peinado & Mateos (1988: 69) referred to it as the holotype. Box L3.

Steropleurus brunnerii (Bolívar, 1877).

dilutus Bolívar, 1878: 442-443, pl. 4, fig. 9 [*Ephippiger*]. Villalba, Matritum circa. Unspecified number of ♂ and ♀.

The three specimens placed under this name in the MHNG were exchanged with Bolívar in 1879; they come from the type locality and may be paralectotypes. Paris (1994) states that a ♀ specimen in the MNMS was inadvertently designated as lectotype when Peinado & Mateos (1988: 68) referred to it as the holotype. Box L6.

Ephippigerida diluta (Bolívar, 1878).

dimidiata Bolívar, 1902: 191-192 [*Paracaedicia*].

Sattelbeg (Huon Golf) (Biro, 1899). Unspecified number of ♂ and ♀.

Two ♀, possibly syntypes. A ♀ with labels: "N. Guinea, Biro 1899." [printed on white card]; "Sattelberg, Huon-Golf" [printed on white card]; "69" [handwritten in pencil on white card]; "Procaecicia dimidiata Bol." [handwritten on white card]; "Possible syntype, Hollier 2014" [handwritten on red paper]. Specimen set with wings folded. A ♀ with labels: "N. Guinea, Biro 1899." [printed on white card]; "Sattelberg, Huon-Golf" [printed on white card]; "Possible syntype, Hollier 2014" [handwritten on red paper]. Specimen set with wings folded. The right middle leg and the claws of the right hind leg are missing. There are three ♀ syntypes in the MNMS (Paris, 1994). (Images on OSF). Box B13.

Procaecicia dimidiata (Bolívar, 1902).

karschi Bolívar, 1903: 170-171 [*Charisoma*].

Sattelberg, Golfe Huon leg. Biro, 1899. Unspecified number of ♂ and ♀.

One ♂ syntype and one ♀ syntype. A ♂ with labels: "N. Guinea, Biro 1899." [printed on white card]; "Sattelberg, Huon-Golf" [printed on white card]; "Charisoma Karschi Bol." [handwritten on white card]; "Syntypus" [printed on red paper]. Specimen set with wings folded. The tarsi of the left front leg are lost. A ♀ with labels: "N. Guinea, Biro 1899." [printed on white card]; "Sattelberg, Huon-Golf" [printed on white card]; "Charisoma Karschi Bol." [handwritten on white card]; "Syntypus" [printed on red paper]. Specimen set with wings folded; the end of the left forewing is split. The end of the tibia and the tarsi of the right hind leg are lost. There are one ♂ syntype and one ♀ syntype in the MNMS (Paris, 1994). Images on OSF. Box D8.

Charisoma karschi Bolívar, 1903.

longipes Bolívar, 1902: 195-196 [*Agnapha*].

Simbang (Biro). Unspecified number of ♂ and ♀.

One ♂ and one ♀, both possibly syntypes. A ♂ with labels: "N. Guinea, Biro 1899." [printed on white card]; "Simbang, Huon Golf" [printed on white card]; "Agnapha longipes Bol. det. Bolivar" [handwritten on white card with "det. Bolivar" printed]; "Possible syntype, Hollier 2014" [handwritten on red paper]. Specimen set with wings folded. A ♀ with labels: "N. Guinea, Biro 1899." [printed on white card]; "Simbang, Huon Golf" [printed on white card]; "Agnapha longipes Bol." [handwritten on white card]; "Possible syntype, Hollier 2014" [handwritten on red paper]. Specimen set with wings folded. The end of the tibia and the tarsi of the right middle leg are missing. There are two ♂ syntypes and two ♀ syntypes in the MNMS (Paris, 1994) (images on OSF). Box B19.

Agnapha longipes Bolívar, 1902.

martinezii Bolívar, 1873: 222-224; plate 9, figure 4 [*Ephippiger*].

Madrid. Unspecified number of ♂ and ♀.

Among the specimens placed under this name in the MHNG are ten examples exchanged with Bolívar in 1879; five are labelled as being from the type locality and might be paralectotypes. The ♀ lectotype, designated by Peinado & Mateos (1986a: 261) is in the MNMS. Paris (1994) questions the validity of the designation because she thinks the specimen designated is not part of the type series, in which case the specimens in the MHNG are possible syntypes. Box L7.

Platystolus martinezii (Bolívar, 1873).

pisifolia Bolívar, 1902 [*Diastellidea*].

Erima, Stephansort, Sattelberg (Biro). Unspecified number of ♂ and ♀.

One ♂, possibly a syntype. A ♂ with labels: "N. Guinea, Biro 1900" [printed on white card with "1900" handwritten over the printed "1899"]; "Stephansort, Astrolabe

Bai" [printed on white card]; "Diastellidea pisifolia Bol." [handwritten on white card]; "Possible syntype, Hollier 2014" [handwritten on red paper]. Specimen set with wings folded. According to OSF the types are lost. Box B13.

Diastellidea pisifolia Bolívar, 1902.

pupulus Bolívar, 1877: 334-335 [*Ctenodecticus*].

Madrid (Saenz Hermual, Ruiz Madrid); Escorial. Unspecified number of ♂ and ♀.

The MHNG collection has four specimens collected by Bolívar, three of them long after the publication of the original description. The fourth was exchanged with the MHNG in 1879, is from one of the type localities and may be a syntype. A ♂ with labels: "Espagne 602-42" [handwritten on a strip of white paper] "Ctenodecticus pupulus ♂ Escorial" [handwritten on white paper]; "Ctenodecticus pupulus Bol. Type! Escorial" [handwritten on pale blue paper]; "Possible syntype Hollier 2014" [handwritten on red paper]. The tarsi of the right front and middle legs, the last tarsal segment of the left hind leg and the claws of the right hind leg are lost. There are seven syntypes in the MNMS (Paris, 1994). Box K6.

Ctenodecticus pupulus Bolívar, 1877.

saussurianus Bolívar, 1878: 442, pl. 4, fig. 8 [*Ephippiger*].

Burgos. Unspecified number of ♂ and ♀.

Among the specimens under this name in the MHNG are three ♂ and two ♀ from the type locality exchanged with Bolívar in 1879 which may be paralectotypes. The ♂ lectotype, designated by Peinado (1986: 97), is in the MNMS (images on OSF). Box L6.

Ephippigerida saussuriana (Bolívar, 1878).

stalii Bolívar, 1877: 284-285; plate 3, figure 11 [*Ephippiger*].

Escorial. Unspecified number of ♂ and ♀.

Among the specimens placed under this name in the MHNG are six examples exchanged with Bolívar in 1879, all from the type locality, which may be paralectotypes. Paris (1994) states that a ♂ specimen in the MNMS was inadvertently designated as lectotype when Peinado & Mateos (1988: 70) referred to it as the holotype. Box L3.

Lluciapomaresius stalii (Bolívar, 1877).

surcularius Bolívar, 1877: 273-275, pl. 4, fig. 9 [*Ephippiger*].

Villaverde (Madrid). Unspecified number of ♂ and ♀.

Among the specimens placed under this name in the MHNG are six examples exchanged with Bolívar in 1879, four of which are labelled as coming from the type locality and which may be paralectotypes. The ♂ lectotype, designated by Peinado & Mateos (1986a: 261), is in the MNMS. Box L7.

Platystolus surcularius (Bolívar, 1877).

terminalis Bolívar, 1902: 192 [*Paracaedicia*].

Stephansort, Simbang, Sattelberg (Biro, 1899). Unspecified number of ♂ and ♀.

One ♀, possibly a syntype. A ♀ with labels: "N. Guinea, Biro 1899." [printed on white card]; "Sattelberg, Huon-Golf" [printed on white card]; "69" [handwritten in pencil on white card]; "Procaecicia terminalis Bol." [handwritten on white card]; "Possible syntype, Hollier 2014" [handwritten on red paper]. Specimen set with wings folded. There is one ♂ syntype and one ♀ syntype in the MNMS (Paris, 1994) (images on OSF). Box B13.

Procaecicia terminalis (Bolívar, 1902).

Other names.

Although the original description of *Hedotettix coactus* Bolívar, 1887 states that there are type specimens in the MHNG, no such specimens could be found (as noted by Paris, 1994). There is a syntype in the MNMS.

The species *Acinipe paulinoi* (Bolívar in Saussure, 1887: 77) is ascribed to Saussure on OSF, but he states that he received the description and not the specimen(s) from Bolívar and credits Bolívar as the author; the species name should therefore be regarded as Bolívar's. Bolívar had received the specimen(s) from Paulino d'Oliveira of Coimbra in Portugal, for whom the species was named. There are no specimens in the MHNG and the whereabouts of the type material is unknown.

The MHNG collection has a series of *Chrotogonus saussurei* Bolívar, 1884, a junior synonym of *C. oxypterus* (Blanchard, 1836), with a handwritten note by Kevan saying "This series is part of that from which *Ch. saussurei* Bol. was described. They are probably not syntypes since none bears Bolívar's determination. D. K. K." The reasoning is faulty, since other Bolívar types do not either, but the conclusion is probably correct because the original description states that the material was in the collection of Brunner von Wattenwyl, to whom Saussure had presumably given part of this series. A similar situation pertains to a series of *Zarytes squalinus* (Saussure, 1884) (see Hollier 2013: 215). The types of both species are in the NHMW.

There is a single specimen in the MHNG collection under the name of *Callimenus ferdinandi* Bolívar, identified by Bolívar and labelled as a syntype. This is one of the specimens mentioned by Uvarov (1934: 70) as having been labelled with this name by Bolívar, although the syntype label is of the characteristic kind used by Malcolm Burr (see Hollier, 2008). Uvarov makes clear that this is a collection name and it is therefore not available, although it would in any case be a junior synonym of *C. latipes* (Stål, 1875). This example is therefore not a type specimen.

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Two additional records of megophryid frogs, *Leptobrachium masatakasatoi* Matsui, 2013 and *Leptolalax minimus* (Taylor, 1962), for the herpetofauna of Vietnam

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Abstract: We record two megophryid species for the first time from Vietnam: *Leptobrachium masatakasatoi* and *Leptolalax minimus*. Acoustic analysis of *L. masatakasatoi* is also reported based on advertisement calls of the male specimen from Son La Province. In addition, data of morphology and natural history of afore mentioned species are provided.

Keywords: Megophryidae - Acoustics - Distribution - New records - Taxonomy - Dien Bien Province - Hoa Binh Province - Son La Province.

INTRODUCTION

The family Megophryidae is one of the most poorly studied group of amphibians in Vietnam. The knowledge about species diversity of this family has remarkably increased from 27 in 2009 to 39 at present (Nguyen *et al.*, 2009; Frost, 2014). A total of nine new species have been described from the country since 2009, namely *Leptolalax applebyi* Rowley & Cao, 2009; *Leptolalax aereus* Rowley, Stuart, Richards, Phimmachak & Sivongxay, 2010; *Leptolalax croceus* Rowley, Hoang, Le, Dau & Cao, 2010; *Leptolalax bidoupensis* Rowley, Le, Tran & Hoang, 2011; *Leptobrachium leucops* Stuart, Rowley, Tran, Le & Hoang, 2011; *Leptolalax nyx* Ohler, Wollenberg, Grosjean, Hendrix, Vences, Ziegler & Bubo, 2011; *Leptolalax firthi* Rowley, Hoang, Le, Dau & Cao, 2012; *Leptolalax botsfordi* Rowley, Dau & Nguyen, 2013; and *Oreolalax sterlingae* Nguyen, Phung, Le, Ziegler & Böhme, 2013 (Rowley & Cao, 2009; Rowley *et al.*, 2010, 2011, 2012, 2013; Ohler *et al.*, 2011; Stuart *et al.*, 2011; Nguyen *et al.*, 2013). In addition, three species were recently recorded for the first time from Vietnam, viz. *Leptobrachium guangxiense* Fei, Mo, Ye & Jiang, 2009; *Leptobrachium promustache* (Rao, Wilkinson & Zhang, 2006); and *Leptolalax eos* Ohler, Wollenberg, Grosjean, Hendrix, Vences, Ziegler & Dubois, 2011 (Bain *et al.*, 2009; Chen *et al.*, 2013; Pham *et al.*, 2014).

We herein report two additional species, *Leptolalax minimus* and *Leptobrachium masatakasatoi*, for the herpetofauna of Vietnam on the basis of a recent amphibian collection from northwestern Vietnam.

MATERIAL AND METHODS

Sampling: Field surveys were conducted in Muong Nhe Nature Reserve of Dien Bien Province, Sop Cop and Cópia nature reserves of Son La Province and Ngoc Son - Ngo Luong Nature Reserve of Hoa Binh Province, Vietnam in April 2012, April 2013, June and July 2013, March 2014, September and October 2014, and January and April 2015 (Fig. 1). Specimens were collected between 19:00 and 24:00. After photographing specimens were anaesthetized in a closed vessel with a piece of cotton wool containing ethyl acetate, fixed in 85% ethanol and subsequently stored in 70% ethanol. Voucher specimens were subsequently deposited in the collections of the Hanoi National University of Education (HNUE), the Institute of Ecology and Biological Resources (IEBR), Hanoi, the Tay Bac University (TBU), Son La Province, and the Muséum d'histoire naturelle (MHNG), Geneva.

Morphological examination: Measurements were taken with a digital caliper to the nearest 0.1 mm. Abbreviations are as follows: SVL: snout-vent length;

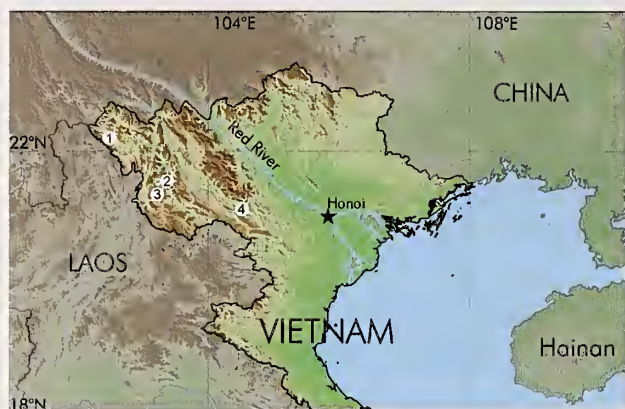


Fig. 1. Map showing the survey sites in northwestern Vietnam. (1) Muong Nhe Nature Reserve in Dien Bien Province; and (2) Copia Nature Reserve; (3) Sop Cop Nature Reserve in Son La Province and (4) Ngoc Son - Ngo Luong in Hoa Binh Province.

EL: eye length, from anterior corner to posterior corner of eye; EN: distance from anterior corner of eye to posterior edge of nostril; HL: head length from posterior corner of mandible to tip of snout; HW: maximum head width, at the angle of jaws; IFE: distance between anterior corners of eyes; IBE: distance between posterior corners of eyes; IN: internarial distance; IUE: minimum distance between upper eyelids; MBE: distance from posterior corner of mandible to posterior corner of eye; MFE: distance from posterior corner of mandible to anterior corner of eye; MN: distance from posterior corner of mandible to posterior edge of nostril; NS: distance from anterior edge of nostril to tip of snout; SL: distance from anterior corner of eye to tip of snout; TYD: maximum tympanum diameter; TYE: distance between anterior margin of tympanum and posterior corner of eye; UEW: maximum width of upper eyelid; FLL: forelimb length, from axilla to tip of third finger; LAL: forearm length, from elbow to base of outer palmar tubercle; HAL: hand length, from base of outer palmar tubercle to tip of third finger; F1L: first finger length; FTL: third finger length, from articulation of proximal and intermediate phalange; HLL: hind limb length, from vent to tip of fourth toe; FL: thigh length, from vent to knee; FOL: foot length, from base of inner metatarsal tubercle to tip of fourth toe; FTL: fourth toe length, from articulation of proximal and intermediate phalange; IMT: length of inner metatarsal tubercle in foot; ITL: inner toe length; TL: shank length; TW: maximum shank width; a.s.l.: above sea level; NR: Nature Reserve. For webbing formula we followed Glaw & Vences (2007).

Acoustic analysis: Advertisement calls were recorded with a Sony Recorder ICD-UX200F with a Parabolic microphone Telinga Pro-4PIP. Calls were recorded at a distance of approximately 0.2 m and ambient

temperatures at the calling site were taken immediately after recording using an electronic thermal hygrometer Nakata NJ-2099-TH. Calls were analyzed by using Raven Pro, version 1.3 (Cornell Laboratory of Ornithology, Ithaca, New York, U.S.A.) at resolution of 16 bit and frequency of 44.1 kHz. Spectrograms were performed with Hann window type, frame length of 1024 samples, and corresponding 3 dB filter bandwidth of 67.4 Hz; frame overlapped 50% with time-grid resolution of 512 samples and frequency-grid resolution of 46.9 Hz. For each acoustic signal, the following parameters were measured: call duration or call length(s): duration of time between beginning and end of a call; call repetition rate (calls/s): (total number of calls-1)/duration of time between beginning of the first call and end of the last call; inter-call interval(s): duration of time between end of the first call and beginning of the second call; number of notes per call: total number of notes in a call; number of pulses per note: total number of pulses within a note (in some cases); dominant frequency of call (kHz): the emphasized harmonic in the spectrum (after Duellman & Trueb, 1994; Cocroft & Ryan, 1995). The first 10 notes of each call were removed according to Pröhl (2003). We calculated the coefficients of variation ($CV = [SD/mean] \times 100\%$) of the acoustic features measured in calls. We employed the criteria of Gerhardt (1991) and classified as static those acoustic properties with average within individual $CV < 5\%$, dynamic those with $CV > 12\%$, and intermediate with CV from 5-12% within-individual variation.

TAXONOMIC ACCOUNT

Leptobrachium masatakasatoi Matsui, 2013

Masatakasato's Eyebrow Toad

Fig. 2

Material examined (n = 12): TBU PAE. 102, 104; 2 adult males; near Hua Ty Village, $21^{\circ}19.865'N$, $103^{\circ}36.796'E$, elevation 1000 m a.s.l., within Copia NR; 22 April 2012; collected by A. V. Pham, T. V. Nguyen and K. T. Do. – TBU PAE. 128; 1 adult male; near Hua Ty Village, $21^{\circ}19.865'N$, $103^{\circ}36.796'E$, elevation 1000 m a.s.l., within Copia NR; 19 April 2013; collected by A. V. Pham, T. V. Nguyen and K. T. Do. – TBU PAE. 114; 1 adult female; near Hua Ty Village, $21^{\circ}19.865'N$, $103^{\circ}36.796'E$, elevation 1000 m a.s.l., within Copia NR; 19 April 2013; collected by A. V. Pham, T. V. Nguyen and K. T. Do. – TBU PAE. 365; 1 adult male; near Nong Vai Village, $21^{\circ}20.216'N$, $103^{\circ}34.822'E$, elevation 1460 m a.s.l., Co Ma Commune, within Copia NR; 9 June 2013; collected by A. V. Pham and T. V. Nguyen. – TBU PAE. 418-419, MHNG 2749.7-8; 4 adult females; near Nam Man Commune, $21^{\circ}01.132'N$, $103^{\circ}34.293'E$, elevation 1670 m a.s.l., within Sop Cop NR; 30 April 2013; collected by A. V. Pham and T. V. Nguyen. – IEBR



Fig. 2. *Leptobrachium masatakasatoi* from Son La Province, Vietnam (TBU PAE.365, adult male). (a) dorsolateral view. (b) Ventral view. Photos A.V. Pham.

A.2015.17; 1 adult male; near Nam Man Commune, 21°01.132'N, 103°34.293'E, elevation 1670 m a.s.l., within Sop Cop NR; 30 April 2013; collected by A. V. Pham and T. V. Nguyen. – IEBR A.2015.18-19; 2 adult males; near Tuc Pha Village, 20°57.911'N, 103°40.410'E, elevation 1270 m a.s.l., Huoi Mot Commune, within Sop Cop NR; 24 January 2015; collected by S. L. H. Nguyen and A. V. Pham.

Description: Morphological characters of specimens from Son La Province agreed well with the description of Matsui (2013): Body elongate, SVL 52.5-59.1 mm in males (mean ± SD 55.6 ± 2.2, n = 7) and 54.7-67.5 mm in females (mean ± SD 61.0 ± 5.6, n = 5) (Table 1). Head wider than long (HL 21.8-25.5 mm, HW 22.7-

27.0 mm, HL/SVL 40.0-45.0% HW/SVL 42.0-46.0% in males; HL 23.3-26.7 mm, HW 23.7-27.5 mm, HL/SVL 40.0-45.3%, HW/SVL 40.0-46.6% in females); snout rounded, barely projecting beyond upper jaw (SL 10.0-11.0 mm in males and 10.0-11.8 mm in females), longer than horizontal diameter of eye (EL 7.2-7.9 mm in males and 7.4-9.0 mm in females); canthus sharp, straight; loreal region oblique, moderately concave; nostril lateral, closer to eye than to tip of snout (NS 5.3-6.1 mm, EN 4.4-4.9 mm in males and NS 5.4-6.3 mm, EN 4.5-5.2 mm in females); interorbital space flat, broader than upper eyelid and internarial distance (IUE 6.9-7.8 mm, UEW 5.2-6.3 mm, IN 4.9-5.3 mm in males and IUE 7.4-8.2 mm, UEW 5.5-6.8 mm, IN 5.0-5.9 mm in females);

Table 1. Measurements (in mm) and proportions of *Leptobranchium masatakasatoi* and *Leptolalax minimus* from Vietnam (Min = minimum, Max = maximum, SD = standard deviation, for other abbreviations see Material and Methods)

| | <i>Leptobranchium masatakasatoi</i> | | | | <i>Leptolalax minimus</i> | | | |
|-----|-------------------------------------|------------|-----------------|------------|---------------------------|------------|-----------------|------------|
| Sex | males (n = 7) | | females (n = 5) | | males (n = 3) | | females (n = 7) | |
| | min – max | mean ± SD | min – max | mean ± SD | min – max | mean ± SD | min – max | mean ± SD |
| SVL | 52.5 – 59.1 | 55.6 ± 2.2 | 54.7 – 67.5 | 61.0 ± 5.6 | 26.0 – 29.3 | 27.3 ± 1.7 | 32.7 – 38.0 | 34.2 ± 1.7 |
| HL | 21.8 – 25.5 | 23.5 ± 1.3 | 23.3 – 26.7 | 25.0 ± 1.7 | 9.9 – 10.9 | 10.3 ± 0.6 | 12.5 – 15.0 | 13.1 ± 0.8 |
| HW | 22.7 – 27.0 | 24.6 ± 1.6 | 23.7 – 27.5 | 25.5 ± 1.8 | 8.8 – 10.0 | 9.3 ± 0.6 | 11.4 – 14.1 | 12.2 ± 0.9 |
| MN | 18.3 – 21.0 | 19.7 ± 1.0 | 19.1 – 23 | 21.1 ± 1.6 | 8.6 – 9.9 | 9.1 ± 0.7 | 10.9 – 13.2 | 11.7 ± 0.9 |
| MFE | 14.8 – 17.5 | 15.8 ± 0.9 | 15.9 – 18.2 | 16.9 ± 0.9 | 6.6 – 7.4 | 6.9 ± 0.5 | 8.5 – 10.5 | 9.2 ± 0.6 |
| MBE | 8.3 – 9.5 | 8.9 ± 0.4 | 9.6 – 10.6 | 10.2 ± 0.5 | 3.5 – 4.2 | 3.8 ± 0.4 | 4.3 – 6.1 | 5.0 ± 0.6 |
| IFE | 9.5 – 11.0 | 10.1 ± 0.5 | 9.7 – 12.2 | 10.8 ± 1.0 | 4.6 – 5.0 | 4.8 ± 0.2 | 5.3 – 6.8 | 5.6 ± 0.5 |
| IBE | 17.0 – 19.4 | 18.2 ± 0.8 | 17.0 – 20.3 | 19.0 ± 1.6 | 7.5 – 8.3 | 7.9 ± 0.4 | 9.0 – 10.9 | 9.8 ± 0.6 |
| IN | 4.9 – 5.5 | 5.2 ± 0.2 | 5.0 – 5.9 | 5.3 ± 0.4 | 2.5 – 2.9 | 2.7 ± 0.2 | 3.0 – 4.0 | 3.3 ± 0.3 |
| SL | 10.0 – 11.0 | 10.5 ± 0.4 | 10.0 – 11.8 | 10.8 ± 0.8 | 3.5 – 4.1 | 3.9 ± 0.3 | 4.5 – 5.3 | 4.9 ± 0.3 |
| NS | 5.3 – 6.1 | 5.8 ± 0.3 | 5.4 – 6.3 | 5.9 ± 0.4 | 1.3 – 1.5 | 1.4 ± 0.1 | 1.6 – 2.2 | 1.8 ± 0.2 |
| EN | 4.4 – 4.9 | 4.7 ± 0.2 | 4.5 – 5.2 | 4.8 ± 0.3 | 1.6 – 2.1 | 1.8 ± 0.3 | 2.4 – 3.5 | 2.8 ± 0.4 |
| EL | 7.2 – 7.9 | 7.6 ± 0.3 | 7.4 – 9.0 | 8.1 ± 0.7 | 3.1 – 4.0 | 3.4 ± 0.5 | 4.3 – 4.9 | 4.6 ± 0.2 |
| IUE | 6.9 – 7.8 | 7.4 ± 0.4 | 7.4 – 8.2 | 7.8 ± 0.4 | 2.8 – 3.3 | 3.0 ± 0.3 | 3.5 – 4.3 | 3.8 ± 0.3 |
| UEW | 5.2 – 6.3 | 5.8 ± 0.4 | 5.5 – 6.8 | 6.0 ± 0.5 | 2.6 – 2.9 | 2.8 ± 0.2 | 3.2 – 4.1 | 3.6 ± 0.3 |
| TYD | 2.8 – 4.0 | 3.2 ± 0.4 | 3.5 – 4.0 | 3.8 ± 0.2 | 1.7 – 2.0 | 1.9 ± 0.2 | 2.0 – 2.8 | 2.3 ± 0.3 |
| TYE | 2.4 – 3.1 | 2.8 ± 0.2 | 2.7 – 3.2 | 2.9 ± 0.2 | 1.3 – 1.5 | 1.4 ± 0.1 | 1.4 – 2.2 | 1.7 ± 0.3 |
| FLL | 38.2 – 43.7 | 40.6 ± 2.1 | 39.8 – 49.2 | 45.5 ± 3.7 | 17.0 – 21.8 | 18.7 ± 2.7 | 21.5 – 27.0 | 23.4 ± 1.8 |
| LAL | 17.0 – 18.8 | 18.1 ± 0.7 | 17.0 – 22.0 | 20.1 ± 2.1 | 6.9 – 7.6 | 7.2 ± 0.4 | 8.0 – 11.0 | 9.0 ± 1.0 |
| HAL | 12.0 – 14.5 | 13.0 ± 0.9 | 12.3 – 15.7 | 13.8 ± 1.4 | 6.3 – 6.7 | 6.5 ± 0.2 | 7.8 – 10.0 | 8.4 ± 0.8 |
| FIL | 7.0 – 7.5 | 7.3 ± 0.2 | 7.0 – 10.1 | 8.4 ± 1.4 | 2.3 – 3.0 | 2.6 ± 0.4 | 2.7 – 4.3 | 3.2 ± 0.5 |
| TFL | 7.3 – 9.0 | 8.0 ± 0.5 | 8.1 – 8.8 | 8.6 ± 0.3 | 3.0 – 3.9 | 3.5 ± 0.5 | 4.3 – 5.0 | 4.6 ± 0.2 |
| HLL | 64.0 – 72.6 | 68.7 ± 3.5 | 64.0 – 78.8 | 72.4 ± 5.7 | 37.0 – 43.0 | 39.7 ± 3.1 | 46.7 – 60.6 | 50.3 ± 4.9 |

| | <i>Leptobrachium masatakasatoi</i> | | | | <i>Leptolalax minimus</i> | | | |
|----------|------------------------------------|--------------|-----------------|--------------|---------------------------|-------------|-----------------|-------------|
| Sex | males (n = 7) | | females (n = 5) | | males (n = 3) | | females (n = 7) | |
| | min – max | mean ± SD | min – max | mean ± SD | min – max | mean ± SD | min – max | mean ± SD |
| FL | 22.3 – 26.0 | 23.7 ± 1.4 | 21.3 – 27.0 | 24.7 ± 2.3 | 11.7 – 13.9 | 12.9 ± 1.1 | 15.0 – 19.4 | 16.1 ± 1.5 |
| TL | 19.0 – 22.0 | 20.7 ± 1.3 | 19.7 – 24.8 | 22.4 ± 2.0 | 12.0 – 14.3 | 13.0 ± 1.2 | 14.4 – 18.3 | 15.7 ± 1.3 |
| TW | 4.5 – 7.2 | 6.1 ± 1.2 | 4.9 – 6.7 | 5.8 ± 0.7 | 3.3 – 3.5 | 3.4 ± 0.1 | 3.0 – 4.5 | 3.7 ± 0.5 |
| FOL | 19.8 – 23.7 | 22.0 ± 1.5 | 20.0 – 25.6 | 22.9 ± 2.2 | 9.8 – 12.7 | 11.4 ± 1.5 | 12.9 – 17.6 | 14.8 ± 1.6 |
| FTL | 10.0 – 11.2 | 10.3 ± 0.5 | 10.1 – 12.0 | 11.2 ± 0.8 | 5.0 – 6.9 | 6.1 ± 1.0 | 7.2 – 9.7 | 8.0 ± 0.9 |
| IMT | 2.6 – 3.2 | 2.9 ± 0.2 | 2.7 – 3.7 | 3.2 ± 0.4 | 1.2 – 1.3 | 1.3 ± 0.1 | 1.2 – 2.0 | 1.4 ± 0.3 |
| ITL | 4.4 – 4.9 | 4.7 ± 0.2 | 4.0 – 5.4 | 4.8 ± 0.7 | 2.1 – 2.3 | 2.2 ± 0.1 | 1.9 – 3.4 | 2.5 ± 0.5 |
| HL/SVL | 0.4 – 0.45 | 0.42 ± 0.02 | 0.4 – 0.43 | 0.41 ± 0.01 | 0.37 – 0.38 | 0.37 ± 0.01 | 0.37 – 0.39 | 0.38 ± 0.01 |
| HW/SVL | 0.42 – 0.46 | 0.44 ± 0.01 | 0.4 – 0.44 | 0.42 ± 0.01 | 0.34 | 0.34 | 0.33 – 0.37 | 0.36 ± 0.02 |
| SL/SVL | 0.18 – 0.2 | 0.19 ± 0.01 | 0.17 – 0.19 | 0.18 ± 0.01 | 0.13 – 0.15 | 0.14 ± 0.01 | 0.13 – 0.15 | 0.14 ± 0.01 |
| MN/ SVL | 0.34 – 0.37 | 0.35 ± 0.01 | 0.33 – 0.36 | 0.34 ± 0.01 | 0.32 – 0.34 | 0.33 ± 0.01 | 0.32 – 0.38 | 0.34 ± 0.02 |
| MFE/SVL | 0.27 – 0.3 | 0.28 ± 0.01 | 0.27 – 0.29 | 0.28 ± 0.01 | 0.25 | 0.25 | 0.25 – 0.28 | 0.27 ± 0.01 |
| MBE/SVL | 0.15 – 0.18 | 0.16 ± 0.01 | 0.16 – 0.18 | 0.17 ± 0.01 | 0.13 – 0.14 | 0.14 ± 0.01 | 0.13 – 0.16 | 0.15 ± 0.01 |
| IFE/SVL | 0.17 – 0.19 | 0.18 ± 0.01 | 0.16 – 0.19 | 0.18 ± 0.01 | 0.17 – 0.18 | 0.17 ± 0.01 | 0.16 – 0.18 | 0.17 ± 0.01 |
| IBE/SVL | 0.31 – 0.36 | 0.33 ± 0.02 | 0.3 – 0.32 | 0.31 ± 0.01 | 0.28 – 0.29 | 0.29 ± 0.01 | 0.27 – 0.3 | 0.29 ± 0.01 |
| IN/SVL | 0.09 – 0.1 | 0.09 ± 0.005 | 0.08 – 0.09 | 0.09 ± 0.004 | 0.09 – 0.11 | 0.1 ± 0.01 | 0.09 – 0.11 | 0.1 ± 0.01 |
| NS/SVL | 0.1 – 0.11 | 0.1 ± 0.01 | 0.09 – 0.1 | 0.10 ± 0.004 | 0.05 | 0.05 | 0.05 – 0.06 | 0.05 ± 0.01 |
| EN/SVL | 0.08 – 0.09 | 0.08 ± 0.005 | 0.08 | 0.08 | 0.06 – 0.07 | 0.07 ± 0.01 | 0.07 – 0.09 | 0.08 ± 0.01 |
| EL/SVL | 0.13 – 0.14 | 0.14 ± 0.01 | 0.13 – 0.14 | 0.13 ± 0.01 | 0.12 – 0.14 | 0.13 ± 0.01 | 0.13 – 0.14 | 0.13 ± 0.01 |
| UEW/SVL | 0.1 – 0.11 | 0.11 ± 0.01 | 0.09 – 0.1 | 0.10 ± 0.004 | 0.1 – 0.11 | 0.1 ± 0.01 | 0.09 – 0.11 | 0.1 ± 0.01 |
| IUE/SVL | 0.13 – 0.14 | 0.13 ± 0.01 | 0.12 – 0.14 | 0.13 ± 0.01 | 0.11 | 0.11 | 0.1 – 0.12 | 0.11 ± 0.01 |
| TYD/SVL | 0.05 – 0.07 | 0.06 ± 0.01 | 0.06 – 0.07 | 0.06 ± 0.004 | 0.07 | 0.07 | 0.06 – 0.08 | 0.07 ± 0.01 |
| TYE/SVL | 0.04 – 0.05 | 0.05 ± 0.01 | 0.04 – 0.06 | 0.05 ± 0.01 | 0.04 – 0.06 | 0.05 ± 0.01 | 0.04 – 0.06 | 0.05 ± 0.01 |
| FLL/SVL | 0.7 – 0.76 | 0.73 ± 0.02 | 0.73 – 0.79 | 0.75 ± 0.03 | 0.64 – 0.74 | 0.68 ± 0.05 | 0.64 – 0.75 | 0.68 ± 0.04 |
| LAL/SVL | 0.3 – 0.34 | 0.33 ± 0.01 | 0.31 – 0.34 | 0.33 ± 0.01 | 0.26 – 0.27 | 0.26 ± 0.01 | 0.24 – 0.29 | 0.26 ± 0.02 |
| HAL/SVL | 0.22 – 0.25 | 0.24 ± 0.01 | 0.21 – 0.24 | 0.22 ± 0.01 | 0.23 – 0.24 | 0.24 ± 0.01 | 0.23 – 0.27 | 0.25 ± 0.01 |
| FIL/SVL | 0.13 – 0.14 | 0.13 ± 0.004 | 0.12 – 0.15 | 0.14 ± 0.01 | 0.09 – 0.1 | 0.09 ± 0.01 | 0.08 – 0.11 | 0.09 ± 0.01 |
| TFL/SVL | 0.14 – 0.15 | 0.14 ± 0.005 | 0.13 – 0.16 | 0.14 ± 0.01 | 0.12 – 0.13 | 0.13 ± 0.01 | 0.13 – 0.15 | 0.14 ± 0.01 |
| HLL/SVL | 1.19 – 1.27 | 1.23 ± 0.03 | 1.15 – 1.25 | 1.19 ± 0.04 | 1.42 – 1.47 | 1.45 ± 0.03 | 1.37 – 1.59 | 1.47 ± 0.09 |
| FL/SVL | 0.41 – 0.45 | 0.43 ± 0.01 | 0.39 – 0.42 | 0.4 ± 0.01 | 0.45 – 0.49 | 0.47 ± 0.02 | 0.45 – 0.51 | 0.47 ± 0.03 |
| TL/SVL | 0.36 – 0.39 | 0.37 ± 0.01 | 0.36 – 0.38 | 0.37 ± 0.01 | 0.46 – 0.49 | 0.48 ± 0.02 | 0.43 – 0.5 | 0.46 ± 0.02 |
| FOL/SVL | 0.38 – 0.42 | 0.39 ± 0.02 | 0.37 – 0.38 | 0.38 ± 0.01 | 0.38 – 0.44 | 0.42 ± 0.03 | 0.39 – 0.47 | 0.43 ± 0.04 |
| FTL/ SVL | 0.17 – 0.21 | 0.19 ± 0.01 | 0.18 – 0.19 | 0.18 ± 0.01 | 0.19 – 0.24 | 0.22 ± 0.03 | 0.21 – 0.26 | 0.23 ± 0.02 |
| ITL/SVL | 0.08 – 0.09 | 0.08 ± 0.01 | 0.07 – 0.08 | 0.08 ± 0.004 | 0.08 | 0.08 | 0.06 – 0.09 | 0.08 ± 0.01 |
| IMT/SVL | 0.05 – 0.06 | 0.05 ± 0.004 | 0.05 – 0.06 | 0.05 ± 0.01 | 0.04 – 0.05 | 0.05 ± 0.01 | 0.03 – 0.06 | 0.04 ± 0.01 |

tympanum indistinct (TYD 2.8–4.0 mm in males and 3.5–4.0 mm in females); tympanum-eye distance (TYE 2.4–3.1 mm in males and 2.7–3.2 mm in females); vomerine teeth absent; tongue heart-shaped, notched posteriorly; vocal openings absent.

Forelimb long (FLL 38.2–43.7 mm in males and 39.8–49.2 mm in females), forearm (LAL 17.0–18.8 mm in males and 17.0–22.0 mm in females), longer than the hand length (HAL 12.0–14.5 mm in males and 12.3–15.7 mm in females); relative finger lengths $II < IV < I < III$; fingers without dermal fringe, free of webbing; tips of fingers rounded, slightly swollen; subarticular tubercle indistinct, 1:1:2:2; palmar tubercles two, oval; nuptial pads absent.

Hindlimb slender, long (HLL 64.0–72.6 mm in males and 64.0–78.8 mm in females); foot longer than tibia (TL 19.0–22.0 mm in males and 19.7–24.8 mm in females; FOT 19.8–23.7 mm in males and 20.0–25.6 mm in females); tibiotarsal articulation reaching to posterior margin of tympanum when limb adpressed along body; relative toe lengths $I < II < V < III < IV$; tips of toes slightly swollen; webbing formula $I1-I111 - I111 1 - 2IV2-1V$; inner metatarsal tubercle distinct, shorter than length of toe I (IMT 2.6–3.2 mm in males and 2.7–3.7 mm in females; ITL 4.4–5.4 mm in males and 4.0–5.4 mm in females); subarticular tubercles indistinct, 1: 1: 2: 3: 2.

Skin. Dorsal surface with fine network of ridges, tubercles present in the posterior region of sacrum, more distinct in anterior part of vent; upper lip without spines in males; supratympanic fold present, from posterior edge of eye to axilla; flanks granular; throat and chest asperities; belly and ventral surfaces of limbs smooth except for granular thigh.

Coloration in life. Dorsal surface light brown or brown-reddish, with dark spots on medial side of upper eyelid, distinct or indistinct in some individual, back with irregularly black spots; supratympanic fold edged in black below; flanks light brown reticulated with large black spots; anterior part of thigh with large dark spots; dorsal limbs light brown with dark crossbars; ventral surface with irregular brown and cream markings.

Acoustic properties (Fig. 3): Calls emitted by the male (IEBR A.2015.19) from Sop Cop NR were recorded at a temperature of 8°C and a relative humidity of 83%. The calls were composed of a single pulsed note, lasting for 0.161–0.244 s (0.199 ± 0.019 ; $n = 27$), repeated at a rate of 1.115–1.218 calls/s (1.166 ± 0.073 ; $n = 2$) and inter-call intervals of 0.259–1.184 s (0.61 ± 0.277 ; $n = 24$). Each note consisted of multipulse. Frequency band of calls ranged between 0.224 and 2.015 kHz (from 0.314 ± 0.05 to 1.771 ± 0.145 ; $n = 26$). The dominant frequency, presenting at about 0.861–1.206 kHz (1.097 ± 0.098 ; $n = 26$). Rise time of calls (mean CV = 9.31%), call repetition rate (mean CV = 6.23%), inter-call interval (mean CV = 45.35%) and dominant frequency (mean CV = 8.87%) were the most stereotyped proper-

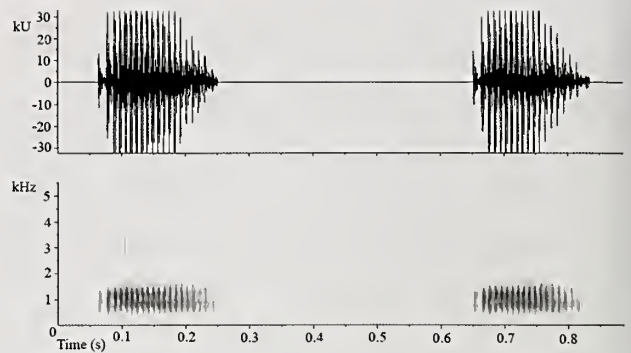


Fig. 3. Advertisement call of *Leptobrachium masatakasatoi* (IEBR A.2015.19, adult male). (a) A 0.8-sec waveform of relative amplitude. (b) Corresponding 0.8-sec spectrogram.

ties. Time of calls, call rate, and dominant frequency can be considered static properties, while inter-call interval can be considered dynamic properties. In comparison with other species of *Leptobrachium* from Vietnam, advertisement calls of *L. masatakasatoi* intensively overlap with those of *L. leucops* and *L. pullum* in both temporal and spectral properties (Stuart *et al.*, 2011; Tran, 2013). All three species emit calls of a single pulsed note, with a dominant frequency at around 1.0 kHz (*L. masatakasatoi* 0.861–1.206 kHz, *L. leucops* 1–1.6 kHz, and *L. pullum* 0.99–1.38 kHz).

Calling behavior: Calling males were found on stream banks in the secondary forest. The smallest distance in between two calling individuals was from 1 to 2 m. This species is quite sensitive for surrounding disturbances such as light or sounds. The calling individuals stayed silence for a long time when they recognized disturbances.

Ecological notes: Specimens of *L. masatakasatoi* were found on the edge of small streams and on forest paths between 20:00 and 24:00. The surrounding habitat was evergreen forest of small hardwood and shrub at elevations between 1000 and 1670 m.

Distribution: This species was previously known only from Laos (Matsui, 2013).

Leptolalax minimus (Taylor, 1962)

Small Asian Toad

Fig. 4

Leptobrachium minimum Taylor, 1962: 320.

Leptolalax (*Lalos*) *minimus*. – Delorme, Dubois, Grosjean & Ohler, 2006: 67.

Material examined (n = 10): TBU PAE.493; 1 adult male; near Hua Ty Village, 21°20.866'N, 103°34.948'E, elevation 1390 m a.s.l., Co Ma Commune, within Copia NR; 22 July 2013; collected by A. V. Pham and T. V. Nguyen. – TBU PAE.566; 1 adult female; near Kha



Fig. 4. *Leptolalax minimus* (IEBR A.2015.22) from Dien Bien Province, Vietnam. (a) dorsolateral view. (b) ventral view. Photos T. Q. Nguyen.

Village, 21°00.365'N, 103°25.913'E, elevation 1190 m a.s.l., Pung Banh Commune, within Sop Cop NR; 2 March 2014; collected by A. V. Pham and D. A. Vi. – IEBR A.2015.20; 1 adult male; near Kha Village, 21°00.365'N, 103°25.913'E, elevation 1190 m a.s.l., Pung Banh Commune, within Sop Cop NR; 20 September 2014; collected by T. Q. Nguyen, A. V. Pham, H. N. Ngo, T. V. Nguyen, H. V. Tu. – MHNG 2749.9; 1 adult female; near Kha Village, 21°00.365'N, 103°25.913'E, elevation 1190 m a.s.l., Pung Banh Commune, within Sop Cop NR; 21 September 2014; collected by T. Q. Nguyen, A. V. Pham, H. N. Ngo, T. V. Nguyen, H. V. Tu. – HNUE MNA.159; 1 adult female; Suoi Do stream, near Nam San village, 22°12.050'N, 102°20.483'E, elevation 1370 m a.s.l., within Muong Nhe NR; 18 February 2013; collected by D. T. Le and H. P. Vu. – HNUE MNA. 335; 1 adult female; Suoi Do stream, near Nam San village, 22°12.050'N, 102°20.483'E, elevation 1370 m a.s.l., within Muong Nhe NR; 22 March 2014; collected by D. T. Le and H. P. Vu. – IEBR A.2015.21; 1 adult male; Hang Doi mountain, near Nam Po village, 22°09.017'N, 102°26.533'E, elevation 910 m a.s.l., within Muong Nhe NR; 11 September 2014; collected by T. Q. Nguyen, D. T. Le, C. T. Pham, and H. N. Ngo. – IEBR A.2015.22, MHNG 2749.10; 2 adult females; Hang Doi mountain, near Nam Po village, 22°09.017'N, 102°26.533'E, elevation 910 m a.s.l., within Muong Nhe NR; 11 September 2014; collected by T. Q. Nguyen, D. T. Le, C. T. Pham, and H. N. Ngo. – IEBR A.2015.23; one adult female; Mu stream, Tu Do Commune, 20°41.597'N, 105°22.107'E, elevation 313 m a.s.l., within Ngoc Son-Ngo Luong NR; 4 October 2014; collected by C. T. Pham and H. N. Ngo.

Description: Morphological characters of specimens from Vietnam agreed well with the descriptions of Taylor (1962) and Ohler *et al.* (2011): SVL 26.0–29.3 mm in males (mean \pm SD 27.3 \pm 1.7 mm, n = 3) and 32.7–38.0 mm in females (mean \pm SD 34.2 \pm 1.7 mm, n = 7) (Table 1).

Head longer than wide (HL 9.9–10.9 mm, HW 8.8–10.0 mm, HL/SVL 47.0–38.0%, HW/SVL 34.0% in males; HL 12.5–15.0 mm, HW 11.4–14.1 mm, HL/SVL 37.0–39.0%, HW/SVL 33.0–37.0% in females); snout protruding, longer than eye diameter (SL 3.5–4.1 mm, EL 3.1–4.0 mm in males; SL 4.5–5.3 mm, EL 4.3–4.9 mm in females); nostrils oval, on lateral side, closer to the tip of snout than to eye (NS 1.3–1.5 mm, EN 1.6–2.1 mm in males; NS 1.6–2.2 mm, EN 2.4–3.5 mm in females); canthus rostralis distinct, loreal region concave; interorbital distance wider than upper eyelid width and internarial distance (IUE 2.8–3.3 mm, UEW 2.6–2.9 mm, IN 2.5–2.9 mm in males; IUE 3.5–4.3 mm, UEW 3.2–4.1 mm, IN 3.0–4.0 mm in females); eye large, pupil vertical; tympanum round, distinct (TYD 1.7–2.0 mm in males and 2.0–2.8 mm in females), greater than distance to posterior corner of eye (TYE 1.3–1.5 mm in males and

1.4–2.2 mm in females); vomerine teeth absent; tongue notched posteriorly.

Forelimb: Forearm rather thin (LAL 6.9–7.6 mm in males, 8.0–11.0 mm in females), longer than hand (HAL 6.3–6.7 mm in males; HAL 7.8–10.0 mm in males); relative finger lengths I<II<IV<III, tips of fingers not enlarged into discs; fingers free of webbing; subarticular tubercles distinct, 1:1:2:2; palmar tubercles round, in contact with each other, inner one very large.

Hindlimb: Thigh short (FL 11.7–13.9 mm in males and 15.0–19.4 mm in females); tibia three times longer than wide (TL 12.0–14.3 mm, TW 3.3–3.5 mm in males; TL 14.4–18.3 mm, TW 3.0–4.5 mm in females); relative toe lengths I<II<V<III<IV; webbing rudimentary between toes I and II and between IV and V, slightly developed between toes II and III, III and IV, webbing formula II–III–2 ½ III–2–IV–3–2V, dermal fringes well developed but absent along outer edge of toe V; subarticular tubercles round, indistinct, 1:1:2:3:2; inner metatarsal tubercle prominent; outer metatarsal tubercle absent.

Skin. Dorsal head smooth, dorsum and upper part of flanks with tubercles and glandular folds; supratympanic fold distinct; dorsolateral fold absent; dorsal surface of limbs with tubercles and glandular folds; ventral surface smooth.

Coloration in life. Upper part of iris dark golden, lower part grey; dorsal surface of head and body brown grey with a triangular marking between eyes, some grey spots in middle of back; dorsolateral region with some small dark spots; dorsal surface of fore and hindlimbs brown grey with dark bars; tympanic region dark brown; upper lip brown with dark bars; posterior part of thigh dark brown with white spots and a large femoral gland on each side; throat and chest transparent grey; border of throat grey with white spots; belly white.

Remarks: The female specimens from Vietnam are slightly larger than those from Thailand and Laos (SVL 32.7–38.0 mm versus 31.6–37.3 mm) (see Ohler *et al.*, 2011).

Ecological notes: Specimens of *L. minimus* were collected between 19:00 and 22:00 on stones at stream banks or on leaves, about 0.3–0.6 m above the forest floor, near rocky streams. The surrounding habitat was mixed evergreen forest or secondary forest of small hardwood, bamboo and shrub.

Distribution: This species was previously known only from Thailand and Laos (Ohler *et al.*, 2011).

DISCUSSION

Leptobrachium masatakasatoi was recently described by Matsui (2013) from Houaphan Province, northeastern Laos. The newly recorded localities in northern Vietnam are approximately 20 km distant from the type locality in Laos. *Leptolalax minimus* was described by Taylor (1962)

from Chiang Mai Province, northern Thailand. This species was recently recorded from Khammouan, Luang Prabang, and Savannakhet provinces in Laos by Ohler *et al.* (2011). The newly recorded localities in Vietnam are approximately 180 km distant from the type locality in Thailand. The new records of *L. masatakasatoi* and *L. minimus* increased the species number of the genus *Leptobrachium* to 10 and of the genus *Leptolalax* to 16 in Vietnam.

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The first discovery of the “*Pheidole quadricuspis* group” in the Indo-Chinese Peninsula (Insecta: Hymenoptera: Formicidae: Myrmicinae)

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Abstract

Pheidole leloi is described as a new species based on a colony series collected in an evergreen forest on the Da Lat Plateau's eastern edge (Hon Ba Nature Reserve, Khanh Hoa Province, Vietnam). It is the first discovery of the *Pheidole quadricuspis* group in the Indo-Chinese Peninsula. The p-distance between COI sequences of *P. leloi* and its putative named allies of the species group is 13.4-15.8%. This may indicate that *P. leloi* has been genetically isolated for several million years. An ancestor of *P. leloi* probably expanded its distribution into the Indo-Chinese peninsula during the Miocene expansions of rainforests, and survived into rainforest patches (refugia) during the Quaternary glacial age.

Key words: *Pheidole leloi* - new species - Vietnam - DNA barcoding - biogeography.

INTRODUCTION

The genus *Pheidolacanthinus* was established by F. Smith (1865) for *Pheidolacanthinus armatus* (junior synonym of *Pheidole quadrispinosa*) and was later demoted to a subgenus of *Pheidole* by Forel (1900). Emery (1921) subdivided “*Pheidolacanthinus*” into three species groups, i.e., *P. quadricuspis* Emery group (Indo-Malayan), *P. quadrispinosa* F. Smith group (Austro-Malayan and Australian), and *P. cervicornis* Emery group (New Guinean). Finally *Pheidolacanthinus* was synonymized with *Pheidole* by D. R. Smith (1979), and his treatment has been widely accepted (see Bolton, 2013). Furthermore, Moreau (2008) and Economo *et al.* (2014) proposed a molecular phylogeny of *Pheidole* of the world and showed the polyphyly of *Pheidolacanthinus* sensu Emery (1921).

Based on morphological similarity Eguchi (2001) inferred that the following named species and several other undescribed species are members of a single lineage equivalent to the *P. quadricuspis* group sensu Emery (1921): *P. acantha* Eguchi, *P. lokitae* Forel, *P. quadrensis* Forel, *P. quadricuspis*, *P. sperata* Forel and *P. spinicornis* Eguchi. They share the following morphological characteristics: (1) promesonotal dome of the major and

minor armed with a pair of long and pointed spines, (2) hypostoma of the major bearing a pair of stout submedian processes; (3) frontal carina of the major and minor inconspicuous or almost absent.

Until recently, the members of the *P. quadricuspis* group had been known from lowland and/or hill rainforests of the Indo-Malayan, the Austro-Malayan and/or the Australian subregions (Eguchi, 2001, 2008, 2011; Eguchi & Yamane, pers. observ.). However, in the course of the authors' last field survey in an evergreen forest on the Da Lat Plateau's eastern edge (Hon Ba Nature Reserve, Khanh Hoa Province, Vietnam), an unknown species having the above-mentioned characteristics was collected. In the present paper, it is described as a new species, and brief biogeographical remarks are provided.

MATERIALS AND METHODS

Abbreviations of the specimen depositories are: VNMN, Vietnam National Museum of Nature, 18 Hoang Quoc Viet, Cau Giay, Hanoi, Vietnam; ACEG, Ant Collection of Katsuyuki Eguchi (see his contact address given under the title of this article); BMNH, the Natural History Museum, Cromwell Road, London, England; MBD, Mu-

seum Brunei, Bandar Seri Begawan, Brunei Darussalam; MCZC, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA; MHNG, Muséum d'Histoire Naturelle, Geneva, Switzerland; MSNG, Museo Civico di Storia Naturale “Giacomo Doria”, Genova, Italy; NHMW, Naturhistorisches Museum Wien, Austria; UMS, Universiti Malaysia Sabah, Kota Kinabalu, Sabah, Malaysia.

Multi-focused, montage images were produced using Helicon Focus Pro 5.3.10 from a series of source images (5184x3456 pixels) taken by a Canon Eos Kiss X5 digital camera attached to a Nikon SMZ-1270 microscope. Fine hairs and other features that were not recognized automatically were copied from the focused parts from the source images on to the montage image using the retouching function of Helicon Focus. Artifacts (ghost images) and unnecessary parts (unfocused appendages, etc.) surrounding or covering target objects were erased and cleaned up using the retouching function of Helicon Focus. Finally, the background was cleaned up, and the color balance, contrast and sharpness were adjusted using Adobe Photoshop CS6.

Photographs (5184 x 3456 pixels) for measuring were taken using a Canon Eos Kiss X5 digital camera attached to the Nikon SMZ-1270 microscope under suitable magnifications, and the following parts of bodies were measured using ImageJ 1.49m (National Institute of Mental Health, USA, available at <http://imagej.nih.gov/ij/>) and then indices calculated: HL, maximal length of head capsule (in cases where anterior margin of clypeus and/or posterior margin of head are concave, the landmarks for measuring are set at the mid-point of a transverse line spanning the anteriormost points and/or posteriormost points); HW, maximal width of head capsule excluding eyes; SL, length of antennal scape excluding the basal condylar bulb; PW, maximal width of promesonotum measured at the bottom in anterodorsal view (major) or in dorsal view (minor); MSW, maximal width of mesoscutum in dorsal view (queen); ML, mesosomal length measured from the mid-point of anterior margin

of promesontal dome to the mid-point of a transverse line spanning the posteriormost points of metapleuron; HFL, length of hind femur; PtL, petiolar length measured from the anterodorsalmost point of petiolar peduncle to the posterodorsal corner of the petiole in lateral view; PtW, maximal width of petiolar node in dorsal view; PPtL, length of postpetiolar tergite (excluding helcium) measured from the anteroventral corner to the posterodorsal corner of the tergite in lateral view; PPtW, maximal width of postpetiole in dorsal view; CI=HW/HLx100; SI=SL/HWx100; MI=ML/PWx100 (major and minor), or MI=ML/MSWx100 (queen); PtI1=PtL/PPtLx100; PtI2=PtW/PPtWx100; HFI=FL/HWx100.

Five dry-mounted specimens were used for DNA barcoding (see under “Description” and “Recognition”). The body was washed with ca. 500 µL TE (pH 8.0) in a sterilized disposable dish and the gaster was partly broken by sterilized forceps. The whole body was then transferred into 105 µL of extraction buffer (100 µL of 10% Chelex-TE solution and 5 µL Qiagen Proteinase K) and incubated at 56°C for 24-48h, and then heated at 99°C for 10 minutes for inactivating Qiagen Proteinase K in the extraction buffer.

The 658-base standard DNA barcoding region (Folmer region) near the 5’ terminus of the CO1 gene was amplified using the primer set LCO-EG/HCO-EG (Table 1). Each PCR contained 5 µL of 2xPCR buffer, 2 µL of dNTPs (final 0.4 mM), 0.3 µL of 10 pmol/µL forward and reverse primers (final 0.3 µM), 0.2 µL of 1.0 U/µL DNA polymerase KOD FX Neo (TOYOBO KFX-2015), and 0.5 µL of DNA template. In cases where the target region was not successfully amplified, three shorter overlapping segments that allowed the creation of a composite sequence of the region were amplified using primer sets LCO-EG/CO1-286R, CI-13-EG/CO1-441R and CO1-362F/CI-14-EG. The PCR thermal regime consisted of one cycle of 2 min at 94 °C; five cycles of 10 sec at 98 °C, 30 sec at 45 °C and 45 sec at 68 °C; 40 cycles of 10 sec at 98 °C, 30 sec at 48.5 °C and 45 sec at 68 °C; and a final cycle of 7 min at 68 °C. Further-

Table 1. Primers used in the present study. Nucleotide positions referring to the mitochondrion complete genome of *Solenopsis invicta* pop-variant PMS (Accession No. HQ215538) are shown.

| Name | Sequence | Position | Reference |
|----------|----------------------------|----------|---|
| LCO-EG | TTTCAACAAATCACAAAGAYATYGG | 17-41 | Modified from Folmer <i>et al.</i> (1994) |
| CI-13-EG | ATAATTTTTTTTATAGTWATRCC | 187-209 | Modified from Hasegawa <i>et al.</i> (2002) |
| CO1-286R | TTATTCGTGGRTADGCYATRTC | 286-265 | Eguchi <i>et al.</i> (2013) |
| CO1-362F | GAACAGGWTGAACWRHTHTAYCC | 362-383 | Eguchi <i>et al.</i> (2013) |
| CO1-441R | TTAATAGCTCCTADRATNGADGATA | 482-458 | Eguchi <i>et al.</i> (2013) |
| CO1-479R | ATTGCYCCTAAATWGADGAYAT | 479-457 | Eguchi original |
| HCO-EG | TAAACTTCAGGRTGACCRAAAAATCA | 725-700 | Modified from Folmer <i>et al.</i> (1994) |

more, in cases where these two methods did not work well, semi-nested PCR were employed. Primer sets were LCO-EG/HCO-EG (outer), LCO-EG/CO1-479R (inner), and CO1-362F/HCO-EG (inner). The PCR thermal regime for both the first and second runs consisted of one cycle of 2 min at 94 °C; 35 cycles of 10 sec at 98 °C, 30 sec at 50 °C and 45 sec at 68 °C; and a final cycle of 7 min at 68 °C. After confirming the PCR amplification on a 2.0% agarose gel, the amplified products were incubated at 37 °C for 30 min and 80 °C for 20 min with Illustra™ ExoStar (GE Healthcare, Buckinghamshire, UK) to remove any excess primers and nucleotides. The cycle sequencing reactions were run with ABI PRISM BigDye Terminator Cycle Sequencing Kit v.3.1 (Applied Biosystems). The sequencing reaction products were purified, concentrated by ethanol precipitation with sodium acetate, and their nucleotide sequences were determined using an automated sequencer (ABI PRISM 3100, Applied Biosystems). The sequences obtained were submitted to the DDBJ database.

These sequences, in addition to the homologue sequences of *Pheidole quadrensis* (Accession No. EF518392.1, Borneo), *P. quadricuspis* (EF518393.1, Borneo) and *P. sexspinosa* (EF518404.1, Palau), were then aligned using Clustal W (Larkin *et al.*, 2007) built in MEGA 6.06 (Tamura *et al.*, 2013). *Pheidole sexspinosa* was included as a representative of the *Pheidolacanthinus quadrispinosa* group sensu Emery (1921). The extensions beyond the Folmer region of *P. sexspinosa*, *P. quadrensis* and *P. quadricuspis* were trimmed, and then pairwise divergences were calculated using the p-distance (obtained by dividing the number of nucleotide differences by the total number of nucleotides compared) and K2P distance model (Kimura, 1980).

DESCRIPTION

Pheidole leloui Eguchi & Bui, sp. n.

Figs 1-13

Type material examined: VNMN; holotype (major); Vietnam, Khanh Hoa, Hon Ba Nature Reserve, 12°07'24"-38"N, 108°58'24"-28"E, ca. 1030-1050 m alt.; K. Eguchi leg.; 16/iii/2013 [colony: Eg16iii13-24]. – VNMN, MCZC, MHNG, ACEG; paratypes; 8 majors, 9 minors, 1 queen from the same colony as holotype; Accession No. LC020537; voucher specimen No. Ext20130410-1 (paratype) from the same colony as holotype (ACEG).

Diagnosis: In the major, vertex as well as dorsal, lateral and ventrolateral faces of vertexal lobe strongly and coarsely reticulate; promesonotal dome with an inconspicuous transverse ridge on its posterior slope; pronotal spine almost straight; posterior slope and lateral face of the dome, mesopleuron and metapleuron irregularly rugoso-reticulate; propodeal spine somewhat

digitiform, with blunt apex; ventral face of petiole with a conspicuous longitudinal carina; anterior half to two thirds of first gastral tergite finely rugoso-punctate. In the minor, posterior part of frons and vertex reticulate; mesosoma relatively densely covered with standing hairs; dorsal face of promesonotal dome weakly punctured, overlain with several rugae, and lateral face of the dome, mesopleuron, metapleuron and dorsal face of propodeum punctate; propodeal spine in lateral view elongate-triangular; petiolar node in lateral view acute at apex, and in posterior view widely and shallowly emarginate at apex.

Description

Major (Figs 1-5): Body dark reddish brown with darker gaster, relatively densely covered with standing hairs (Figs 1, 2, 4, 5). Head in full-face view subrectangular, with its posterior margin narrowly and shallowly emarginated medially, in lateral view relatively thick, faintly impressed on vertex; frons longitudinally rugoso-reticulate; vertex, and dorsal, lateral and ventrolateral faces of vertexal lobe strongly and coarsely reticulate; gena longitudinally rugose; frontal carina almost absent or present just as rugula(e); antennal scrobe absent; median portion of clypeus almost smooth or faintly rugose longitudinally, with a few longitudinal rugae laterally; median longitudinal carina of clypeus relatively distinct; hypostoma with a pair of stout submedian processes ("SM" in Fig. 3) but without median process; lateral processes of hypostoma present but tiny ("L" in Fig. 3); masticatory margin of mandible with apical and preapical teeth, and a tooth in front of basal angle; outer surface of mandible smooth except its base, scattering relatively long decumbent/appressed hairs; antenna with 3-segmented club; maximal diameter of eye longer than or almost as long as antennal segment X. Promesonotal dome with an inconspicuous transverse ridge on its posterior slope; pronotal spine long, slender, almost straight, with pointed apex; anterior slope of promesonotal dome largely smooth with several transverse rugae; posterior slope and lateral face of the dome, mesopleuron and metapleuron irregularly rugoso-reticulate; propodeum irregularly rugoso-reticulate dorsally, longitudinally rugose laterally, and transversely rugose posteriorly; propodeal spine somewhat digitiform, with blunt apex. Ventral surface of midcoxa and hindcoxa smooth. Petiole longer than postpetiole (excluding helcium); petiolar node in lateral view blunt at apex, in posterior view widely and shallowly emarginate at apex, in dorsal view laterally with a narrow flange; ventral face of petiole with a conspicuous longitudinal carina; postpetiole in dorsal view much broader than long, somewhat spindle-shaped; its anteroventral part forming a sharp transverse ridge. Anterior half to two thirds of first gastral tergite finely rugoso-punctate.

Holotype (major): HL, 2.36 mm; HW, 2.62 mm; SL, 1.22 mm; ML, 2.27 mm; PW, 1.18 mm; HFL 1.76 mm; PtL 0.58 mm; PtW 0.47 mm; PPtL 0.45 mm; PPtW



Figs 1-5. *Pheidole leloi* sp. nov., major. (1) Head in full-face view. (2) Head in lateral view. (3) Hypostoma in ventral view: (SM) submedian processes; (L) lateral processes. (4) Mesosoma and waist in lateral view. (5) Body in dorsal view.

0.77 mm; CI, 111; SI, 46; MI, 193; HFI, 67; Ptl1, 130; Ptl2, 62. Paratype majors (n=8): HL, 2.39-2.49 mm; HW, 2.55-2.71 mm; SL, 1.18-1.24 mm; ML, 2.23-2.35 mm; PW, 1.16-1.20 mm; HFL, 1.74-1.80 mm; PtL, 0.61-0.67 mm; PtW, 0.46-0.52 mm; PPtL, 0.45-0.49 mm; PPtW, 0.77-0.86 mm; CI, 107-110; SI, 45-47; MI, 188-198; HFI, 65-68; Ptl1, 128-145; Ptl2, 60-63.

Minor (Figs 6-9): Body dark reddish brown, relatively densely covered with standing hairs (Figs 6, 8, 9). Anteromedian part of frons largely smooth; posterior part of frons and vertex reticulate; area between antennal insertion and eye, and gena rugose; preoccipital carina conspicuous dorsally and laterally; median portion of clypeus slightly punctate, with a median longitudinal carina; masticatory margin of mandible with apical and preapical teeth followed by several small teeth; 1 or 2 small denticles between the preapical tooth and 3rd tooth; outer surface of mandible longitudinally rugose, scattered with long decumbent hairs; antenna with 3-segmented club; scape extending far beyond posterolateral margin of head; maximal diameter of eye shorter than antennal segment X. Promesonotal dome with a pair of spines that are long, slender and pointed apically; posterior slope of the dome with an inconspicuous transverse ridge; dorsal face of the dome weakly punctate, overlain with several rugae; lateral face of the dome, mesopleuron, metapleuron and dorsal face of propodeum punctate; propodeal spine in lateral view elongate-triangular. Petiole a little longer than postpetiole (excluding helcium); petiolar node in lateral view acute at apex, and in posterior view widely and shallowly emarginate at apex; ventral face of petiole without any process and longitudinal carina.

HL, 0.97-1.01 mm; HW, 0.89-0.93 mm; SL, 1.21-1.27 mm; ML, 1.42-1.50 mm; PW, 0.61-0.65 mm; HFL, 1.36-1.43 mm; PtL, 0.31-0.34 mm; PtW, 0.14-0.16 mm; PPtL, 0.28-0.29 mm; PPtW, 0.31-0.34 mm; CI, 91-93; SI, 134-138; MI, 227-235; HFI, 152-155; Ptl1, 111-119; Ptl2, 45-49.

Queen (Figs 10-13): Body dark reddish brown with darker gaster, relatively densely covered with standing hairs (Figs 10, 12, 13). Head in full-face view subtrapezoidal, with its posterior margin broadly and shallowly concave, in lateral view relatively thick, not impressed on vertex, with its posterior margin narrowly and shallowly emarginated medially; frons longitudinally rugoso-reticulate; vertex, and dorsal, lateral and ventrolateral faces of vertexal lobe strongly and coarsely reticulate; gena longitudinally rugose; frontal carina present just as rugula(e); antennal scrobe absent; median portion of clypeus faintly rugose longitudinally, with a few longitudinal rugae laterally; median longitudinal carina of clypeus relatively conspicuous; hypostoma with a pair of stout submedian processes but without median process; lateral processes of hypostoma present but tiny; masticatory margin of mandible with apical and preapical teeth, and a tooth in front of basal angle; outer surface of mandible smooth except its base, scattered with relatively long decum-

bent to appressed hairs; antenna with 3-segmented club; maximal diameter of eye longer than or almost as long as antennal segment X; median ocellus in full-face view located a little behind the level of the posterior margin of compound eye; maximum diameter of median ocellus a little longer than the distance between the median and lateral ocelli (Fig. 11). Mesosoma fully segmented; pronotum almost smooth anteriorly and reticulate laterally; pronotal spine stout and straight, directing anterolaterad; mesoscutum longitudinally rugose medially and irregularly rugoso-reticulate laterally; parapsidal line weakly recognized; scuto-scutellar suture present as a deep and broad impression; mesoscutellum largely smooth dorsally; mesopleuron irregularly rugoso-reticulate, subdivided into anepisternum and katepisternum; metapleuron irregularly rugoso-reticulate; propodeum longitudinally rugose laterally, and transversely rugose posteriorly; propodeal spine somewhat digitiform, with blunt apex. Ventral surface of midcoxa and hindcoxa smooth. Petiole longer than postpetiole (excluding helcium); petiolar node in lateral view blunt at apex, in posterior view widely and shallowly emarginate at apex, in dorsal view laterally with a narrow flange; ventral face of petiole with a conspicuous longitudinal carina; postpetiole in dorsal view much broader than long, somewhat spindle-shaped; its anteroventral part forming a sharp transverse ridge. Anterior three fifths of first gastral tergite finely rugoso-punctate.

HL, 2.10 mm; HW, 2.50 mm; SL, 1.21 mm; ML, 3.19 mm; MSW, 2.03 mm; HFL, 1.90 mm; PtL, 0.82 mm; PtW, 0.72 mm; PPtL, 0.60 mm; PPtW, 0.91 mm; CI, 119; SI, 48; MI, 157; HFI, 76; Ptl1, 136; Ptl2, 79.

Bionomics: The type series (a single colony) was collected from rotten wood on the forest floor of a relatively disturbed patch of an evergreen forest at an altitude of ca. 1,000 m.

SIMILAR SPECIES

Pheidole leloi can be morphologically well distinguished from *P. quadricuspis* and its named allies as follows (see also "Diagnosis" of *P. leloi*).

Pheidole acantha Eguchi, 2001

Pheidole acantha Eguchi, 2001: 25-27.

Type material examined: BMNH, MCZC, MSNG, NHMW, UMS; Malaysia, Sabah, Taman Kinabalu (KPHQ); K. Eguchi leg. [colony No.: Eg97-BOR-404, type images: CASENT0901618 and CASENT0901619 of AntWeb (<http://www.antweb.org/>)].

Nontype material examined: ACEG; Malaysia, Sabah, Taman Kinabalu (KPHQ); K. Eguchi leg. [Eg97-BOR-377 (Accession No. LC020538: voucher specimen No. Ext20131019-10), -386], Mt. Kinabalu, ca. 1500 m



Figs 6-8. *Pheidole leloi* sp. nov., minor. (6) Head in full-face view. (7) Right antenna. (8) Mesosoma and waist in lateral view.



Figs 9-11. *Pheidole leloi* sp. nov. (9) Minor, mesosoma and waist in dorsal view. (10) Queen, head in full-face view. (11) Queen, ocelli.

alt., T. Kikuta leg. [7IV0714-1-B1; 15Q12S3, 15Q22B5; 118AC, 177A, 179A, 185A], Mt. Kinabalu, ca. 1800 m alt., T. Kikuta leg. [593A, 604A, 607A, 617A, 626A, 664A, 668A, 873A].

Distinction from *P. leloi*: In the major, promesonotal dome with a conspicuous transverse ridge on its posterior slope; ventral face of petiole without a longitudinal carina. In the minor, dorsum of mesosoma in profile bearing less than 10 standing hairs.

Pheidole lokitae Forel, 1913

Pheidole (*Pheidolacanthinus*) *lokitae* Forel, 1913: 46.
Pheidole lokitae. – Smith, D.R., 1979: 1365.

Type material examined: MNHG; Indonesia, Central Sumatra, Bandar Baroe; v. Buttel-Reepen leg. [9 syntypes (3 majors, 3 minors, 3 queens), type images: CASENT0907766 and CASENT0907767 of AntWeb (<http://www.antweb.org/>)].

Nontype material examined: ACEG; Malaysia, Sabah, Mahua Waterfall area, ca. 1000 m alt., Crocker Range N. P., K. Eguchi leg. [Eg00-BOR-102]. – ACEG; Indonesia: North Sumatra, Parapat, 900 m alt., Danau Toba, Sk. Yamane leg. [SU02-SKY-95, -96 (Accession No. LC020541: voucher specimen No. Ext20130415-2)]; W. Sumatra, Padang, Sukarami, F. Ito leg. [FI92-78, FI96-153, -180].

Distinction from *P. leloi*: In the major, promesonotal dome with a conspicuous transverse ridge on its



Figs 12-13. *Pheidole leloi* sp. nov., queen. (12) Mesosoma and waist in lateral view. (13) Mesosoma and waist in dorsal view.

posterior slope; ventral face of petiole without a longitudinal carina. In the minor, propodeal spine extremely long; petiolar node in lateral view blunt at apex.

***Pheidole quadrensis* Forel, 1900 complex**

Pheidole quadrensis Forel, 1900: 25.

Pheidole (*Pheidolacanthinus*) *quadrensis*. – Forel, 1913: 45.

Type material examined: MHNG; Indonesia, Sumatra, Kajactonam, Sumatra; M. Weber leg.; 1888 [holotype (major), type images: CASENT0907768 of AntWeb (<http://www.antweb.org/>)].

Nontype material examined: ACEG; Malaysia, E. Malaysia, Sabah, Mahua Waterfall area, ca. 1000 m alt.,

Crocker Range N. P., K. Eguchi leg. [Eg00-BOR-129 (Accession No.: EF518392.1)], Poring, 450-500 m alt., Kinabalu Park; K. Eguchi leg. [Eg96-BOR-279], Poring, 600 m alt., T. Kikuta leg. [06Q36B5], Poring, 900 m alt., T. Kikuta leg. [512-A; 7IV0510-7-1-a]. – ACEG; Sepilok Forest, K. Eguchi [Eg97-BOR-471; Eg98-BOR-870, -876], Tawau Hills N. P., K. Eguchi leg. [Eg96-BOR-034]; Tawau, Gunong Rara, K. Eguchi [Eg96-BOR-328; Eg97-BOR-542, -535, -571], Sarawak, Miri, Lambir N. P., K. Eguchi [Eg98-BOR-806, -822], Bako, F. Ito leg. [FI96-535], Bt. Entimau, 390 m alt., Mahmud leg., 20/iv/1994. – ACEG; Indonesia, W. Sumatra, Padang, Ulu Gaduk, F. Ito leg. [FI97-440], 28/iii/1997 [FI97-499], Lubuk Gadang, Sk. Yamane leg., 21-23/viii/1985; Sitiung, F. Ito leg. [FI93-255]. – ACEG; Brunei, Tutong, Tasek Merimbun, K. Eguchi leg. [Eg99-BOR-052, -535];

Eg00-BOR-070], Temburong, Kuala Belalong Field Studies Centre, K. Eguchi [Eg99-BOR-217].

Distinction from *P. leloi*: In the major, propodeal spine in lateral view broadly based, pointed apically. In the minor, petiolar node in lateral view blunt at apex, and in posterior view not emarginate at apex.

Remarks: *Pheidole quadrensensis* sensu Eguchi (2001) is highly heterogenous in worker morphology and undoubtedly constitutes a species complex. Thus, it needs to be revised based on future intensive sampling in Sumatra and the Malay Peninsula. However, *Pheidole leloi* is morphologically distinguishable from the complex as mentioned above.

Two minors collected by v. Buttel-Reepen from Maxwell's Hill, Taiping, Malacca, and labeled as types (CASENT0904266 and CASENT0907769) (see Forel, 1913) were treated as "syntypes" of *P. quadrensensis* by the AntWeb. However, the original description (Forel, 1900) was based on a single major collected by M. Weber from Kajactonam, Sumatra (CASENT0907768). Actually, the two minors seem to be related to *P. aristotelis* Forel, 1911 (see Eguchi, 2001 for diagnosis of *P. aristotelis*).

Pheidole quadricuspis Emery, 1900

Pheidole quadricuspis Emery, 1900: 683.

Pheidole (*Pheidolacanthinus*) *quadricuspis*. – Emery, 1921: 683.

Type material examined: MSNG; Indonesia, Sumatra, Si-Rambé; E. Modigliani leg.; xii/1890-iii/1891 [3 syntypes (1 major, 2 minor), type images: CASENT0904267 and CASENT0905766 of AntWeb (<http://www.antweb.org/>)].

Nontype material examined: ACEG; Malaysia, Selangor, Ulu Gombak, F. Ito leg. [FI96- 604, -605; FI98-113, -114, -130, -188, -197], Pahang, Cameron Highlands, ca. 1000 m alt., F. Ito leg. [FI92MCH-16, -32], Malaysia, Sabah, Gunong Rara, K. Eguchi leg. [Eg96-BOR-315, -319, -320, -343A, -343B, -353, -370, -372; Eg97-BOR-530, -557, -558], Sepilok forest, K. Eguchi leg. [Eg97-BOR-495]. – ACEG; Brunei, Tutong, Tasek Merimbun, K. Eguchi leg. [Eg99- BOR-039, 111, 112, 522, 585. – ACEG; Eg00-BOR-037 (Accession No.: EF518393.1), 048, -057, -058], Temburong, Kuala Belalong Field Studies Centre, K. Eguchi leg. [Eg99-BOR-222]. – ACEG; Indonesia, East Kalimantan, Kutai N. P.; Sk. Yamane leg., 13/ ix/1993, North Sumatra, Pulau Nias (Lotu), Sk. Yamane leg. [SU02-SKY-126, -134, -137], West Sumatra, Lubuk Gadang; Sk. Yamane leg., 21-23/viii/1985. – ACEG; Philippines, Camarines Sur, Naga City, Panicuason Vill., D. General *et al.* leg., 7/iii/2003.

Distinction from *P. leloi*: In the major, anterior part of vertex longitudinally rugose. In the minor, head almost

completely smooth, with a few standing hairs; dorsal face of promesonotal dome smooth dorsomedially, and weakly punctate anterodorsally, laterally and posterodorsally; mesosoma lacking standing hairs; petiolar node in lateral view blunt at apex, and in posterior view not emarginate at apex.

Pheidole sperata Forel, 1915

Pheidole (*Pheidolacanthinus*) *sperata* Forel, 1915: 29-31.

Type material examined: MHNG; Indonesia, Sumatra, Simalur, Sinabang; E. Jacobson leg.; ii/1913 [4 syntypes (2 majors, 2 minors), type images: CASENT0907770 and CASENT0907771 of AntWeb (<http://www.antweb.org/>)].

Nontype material examined: ACEG; Indonesia, West Java, Mt. Halimon, F. Ito leg. [FI96-259, -297, -283, -302; FI98-309], M. Kawamura leg. [No. 161; No. 10/16a (Accession No. LC020540: voucher specimen No. Ext20130524-3)].

Distinction from *P. leloi*: In the major, ventrolateral face of vertexal lobe weakly and finely rugoso-punctate; lateral face of promesonotal dome, mesopleuron, metapleuron and dorsal face of propodeum punctate; first gastral tergite finely punctate over the surface or in anterior half to two thirds. In the minor, dorsum of mesosoma sparsely with relatively short standing hairs; dorsal faces of head and promesonotal dome punctate but not overlain with rugae; petiolar node in lateral view blunt at apex, and in posterior view not emarginate at apex.

Pheidole spinicornis Eguchi, 2001

Pheidole spinicornis Eguchi, 2001: 116-117.

Type material examined: BMNH, MBD, MCZC, MSNG, NHMW, UMS; Malaysia, Sabah, Sepilok Forest; K. Eguchi leg. [Eg98-BOR-880 (Accession No. LC020539: voucher specimen No. Ext20131029-1), type images: CASENT0901620 and CASENT0901621 of AntWeb (<http://www.antweb.org/>)].

Nontype material examined: ACEG; Malaysia, Sabah, Poring, 500 m alt., Kinabalu Park, H. Hirosawa leg., 20/ vii/1997, Poring, 600 m alt., T. Kikuta leg. [6x2906-5-Bd], Sayap Kinabalu, ca. 1000 m alt., K. Eguchi leg., 15/vii/1996.

Distinction from *P. leloi*: In the major, promesonotal dome with a pair of spines which slightly or weakly curve backward, with a distinct transverse ridge on its posterior slope; first gastral tergite finely punctate over the surface. In the minor, propodeal spine horn-like, weakly downcurved; petiolar node in lateral view blunt at apex, and in posterior view not emarginate at apex.

BIOGEOGRAPHICAL REMARKS

Pheidole leloi has so far been collected just once from an evergreen forest located in the Da Lat Plateau’s eastern edge despite our long-term intensive surveys in various localities of Vietnam (Eguchi, 2008, 2011). In contrast with southern Vietnam under the subtropical climate with relatively distinct dry season, along the Da Lat Plateau’s eastern edge annual rainfall reaches 3,850 mm and there is essentially no dry season (Sterling *et al.*, 2006). This suggests that *P. leloi*, as well as *Pheidole quadricuspis* and its allies (Eguchi, 2001), are adapted to humid wood-
ed environments.
The p-distance between COI sequences of *P. leloi* and its putative allies, i.e., *P. acantha*, *P. lokitae*, *P. quadrensis* complex, *P. quadricuspis*, *P. sperata*, *P. spinicornis*, is 13.4-15.8% (Table 2). Previous studies (Brower, 1994; Quek *et al.*, 2004) estimated that nucleotide substitution rate of COI is around 1.3-2.3% per million years in several arthropod groups including Insecta. When extrapolating this value to our case, *P. leloi* may have been genetically isolated for several million years.
In the middle and late Miocene rainforests periodically extended from tropical Asia northward to southern China or even to Japan (Morley, 1998). Although, in the Quaternary fluctuations between wetter and drier climates became more pronounced, rainforest refugia persisted in north Sumatra, the Mentawai Islands, north Borneo, west Java, northeast Indochina and southern India, and some of these refugia are located at 1,000 meters or more in altitude (Brandon-Jones, 1998). Such paleoclimatic phe-

nomena seem to explain the present isolation of *P. leloi* from its possible relatives, i.e., an ancestor of *P. leloi* probably expanded its distribution into the Indo-Chinese peninsula during the Miocene expansions of rainforests, and survived into rainforest patches (refugia) during the Quaternary glacial age.

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Table 2. Pairwise divergences calculated using the p-distance (upper right) the K2P distance model (lower left). The p-distance is shown indicated by percentage. Nucleotide positions referring to the mitochondrion complete genome of *Solenopsis invicta* pop-variant PMS (Accession No. HQ215538) are shown.

| | Species name Position | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|-------|-------|-------|-------|-------|-------|-------|------|
| 1 | <i>P. leloi</i> sp. n. 42-699 | | 15.7 | 15.8 | 14.6 | 15.2 | 13.4 | 14.0 | 15.4 |
| 2 | <i>P. acanthi</i> 42-665 | 0.179 | | 17.4 | 17.3 | 15.9 | 15.5 | 15.1 | 17.6 |
| 3 | <i>P. lokitae</i> 46-687 | 0.178 | 0.203 | | 15.9 | 16.7 | 15.6 | 15.8 | 15.6 |
| 4 | <i>P. quadrensis</i> complex 42-699 | 0.165 | 0.202 | 0.182 | | 13.4 | 13.5 | 13.1 | 15.7 |
| 5 | <i>P. quadricuspis</i> 42-699 | 0.172 | 0.182 | 0.192 | 0.150 | | 10.5 | 11.2 | 15.9 |
| 6 | <i>P. sperata</i> 77-699 | 0.149 | 0.176 | 0.177 | 0.152 | 0.115 | | 10.6 | 14.8 |
| 7 | <i>P. spinicornis</i> 42-699 | 0.157 | 0.171 | 0.179 | 0.146 | 0.123 | 0.116 | | 14.2 |
| 8 | <i>P. sexspinosa</i> 58-699 | 0.174 | 0.205 | 0.176 | 0.179 | 0.181 | 0.166 | 0.158 | |

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Annotated type catalogue of the Orthalicoidea (Mollusca, Gastropoda, Stylommatophora) in the Muséum d'histoire naturelle, Geneva

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Abstract

The type status is described for 101 taxa classified within the superfamily Orthalicoidea and present in the Mollusca collection of the Muséum d'histoire naturelle in Geneva. A lectotype is designated for *Helix* (*Cochlogena*) *citrinovitrea* S. Moricand, 1836. *Bulimus fidaensis* J. Moricand, 1858 is now considered a junior subjective synonym of *Bulimus clouei* Pfeiffer, 1857. New combinations are: *Kuschelenia* (*Bocourtia*) *angrandi* (Morelet, 1860), *Leiostracus fidaensis* (J. Moricand, 1858), *Protoglyptus heterogrammus* (S. Moricand, 1836), *Protoglyptus longisetus* (S. Moricand, 1846), *Drymaeus* (*Mesembrinus*) *polygrammus* (S. Moricand, 1836), *Kara viriata* (Morelet, 1863).

Keywords: Amphibulimidae - Bulimulidae - Bothriembryontidae - Odontostomidae - Orthalicidae - Simpulopsidae - type material - biohistory.

INTRODUCTION

Annotated catalogues of type specimens are an important source of information on the primary types that constitute the basis of a stable taxonomy for a group. For the superfamily Orthalicoidea, with more than 1750 available taxa names, this has partly been achieved by the papers of Zilch (1971, 1972), Neubert & Janssen (2004), Köhler (2007), Breure (1975, 1976, 2011, 2012, 2013), Breure & Ablett (2011, 2012, 2014, 2015), and Breure & Whisson (2012). Breure (1979) and Breure & Schouten (1985) listed all the primary type material for this group, known at that time. During the course of an ongoing revision of the Orthalicoidea, which now also includes phylogenetic research (Breure *et al.*, 2010; Breure & Romero, 2012), it became evident that a re-study of types and a documentation with present-day standards were needed to ensure a stable taxonomy at the species level. The classification of the group at the family level has recently been revised by Breure & Romero (2012), who recognized in total seven families based on phylogenetic relationships: the Neotropical families Amphibulimidae, Bulimulidae, Megaspiridae, Odontostomidae, Orthalicidae, and Simpulopsidae; the family Bothriembryontidae has a Gondwana distribution. Except the Megaspiridae, all families are represented in the Muséum d'histoire naturelle de Genève by type material, which will be documented in this paper. It must be emphasized, however, that the current systematic

position under each taxon does not imply a revision, but generally follows the understanding of recent authors (e.g., Richardson, 1993, 1995; Simone, 2006; Neubert *et al.*, 2009; Thompson, 2011). To supplement the systematic data, a brief introduction is given to the collection and how the material found is interpreted in their historical context.

The collection

The museum, which was founded in 1820, has a rich historical collection. Cailliez (1983, 1995) has described its history in great detail, but some highlights are summarized herein. According to Cailliez (1995) the provenance of the oldest shells dates back to François Valentijn (1656-1727), who wrote a large compilation of Dutch natural history and 'rariteiten' cabinets and is considered as an eager collector himself (Smit *et al.*, 1986: 281). After his death his collection was probably auctioned, as usual in those days (van de Roemer, 2004: 50), and his shells came into possession of Christian H. Hwass (1731-1803). Another collection was those of the Dutch dealer in natural curiosities Nicolaas Anderson (16**.-1746), who sold one of his cabinets to Pieter Lyonet (1706-1789) ca. 1750 (Hublard, 1910: 87); his collection in turn was publicly sold in the Hague in 1796 and parts were acquired by Hwass, Louis J.B.M. Sollier de la Touche (1757?-1819?), and Jean-Baptiste

P.A. Lamarck (1744-1829). The collection of Sollier de la Touche, which contained the Hwass collection as well, was acquired by François V.N. Masséna (1799-1863), who also acquired that of Lamarck in 1831. In turn Masséna's collection ended up in 1840 in those of Benjamin Delessert (1773-1847). After his death the collection passed to the hands of his brother François and, finally after his death in 1868, was donated to the city of Geneva and incorporated in the museum. The importance of Delessert's collection has been elaborated by Cailliez & Finet (1997: 7-18).

For the context of this paper the specimens described by Lamarck are of importance, together with the collections of Alcide d'Orbigny (partially; see also Breure, 1975; Breure & Ablett, 2011, 2012, 2014, 2015), and Stefano Moricand (1779-1854) and his son Jacques (1823-1877) (see also Breure & Tardy, 2016). Furthermore, the collections of Léonce Angrand (1808-1886), from which a number of Peruvian species were described by Arthur Morelet in 1863, and Auguste Brot (1821-1896) are rich sources of Neotropical material. The collection of Angrand was donated to the Geneva museum in 1881, and was partially curated by Brot (Anonymous, 1882: 35-36, 39). Brief biographies of some of the persons mentioned may be found in Cailliez (1995: 12-19, 22-25).

Labels, author's handwriting and matching specimens

Although in historical collections labels are mostly the sole source of information of work done by malacologists in the past, we can often obtain an impression of how they worked once we carefully research the context, i.e. the relationship between their labels and their published work, the presence (or absence) of original labels with material that they received from other sources, etc.

In this collection, the two main sources which are relevant for this study (viz. the Moricand and Angrand collections), provide some glimpses of the past. Both father and son Moricand have a similar handwriting, which sometimes may prove to be confusing (Breure & Tardy, 2016). Generally, the labels of S. Moricand follow the same scheme: the top line is for the taxon name, where applicable the name of a previous author (e.g., Spix or d'Orbigny) on the next line, followed by a reference to a source (mostly Pfeiffer's *Monographia*); at the bottom line the locality (as short as possible) at left, and the supplier of the material at right. However, it must be noted that Moricand has not always been consistent in the name on the labels versus the name published in his papers. This is especially evident with some of his varietal names, for which he seems to have changed his mind after his initial label had been written. On early labels from his hand several eases were found, related to material received from Blanchet, where a number seems to refer to a shipping list; these lists have not been found in the archive. J. Moricand's labels are more concise, with only the taxon name, locality, and supplier.

Both father and son had the habit to copy the label they received from suppliers, and throw away the original (see Breure & Tardy, 2016 for a list of sources of material). In the case of other malacologists this is very unfortunate, as part of the information is destroyed. For this reason specimens originating from the Cuming collection and dealing with species described by e.g., Pfeiffer, have not been considered as possible type material as it is unclear when this material arrived in Geneva (cf. Neubert & Janssen, 2004: 196, who had evidence that Cuming material arrived in 1845 in the SMF, and thus could contain material of previously described taxa as type material). In the case of Blanchet's material, the published localities are generally a bit more extensive, and these may have been copied from the shipping lists. Since Blanchet sent material to Geneva over a prolonged time, it happened that S. Moricand first described a new species on the basis of scant material, and later received more specimens. These different sendings have been mixed by Moricand in most cases and are the reason why it proved to be difficult – or impossible – to recognise the original series by the failure to untangle the present-day lot. In those cases generally the whole lot has been considered as type material, although this violates a strict interpretation of 'original series'. Further details on the Moricand collection and its history can be found in Breure & Tardy (2016).

The second collection of primary interest, that of Angrand, posed a different challenge. While it is clear that it contains material used by Arthur Morelet for his publications on Peruvian material (Morelet, 1860, 1863), the labelling is partly problematic. On one hand, Angrand seems to have collected in a very organised way. Some shells were still found glued on sheets of paper, marked with a year and a number in print. It is possible that localities were listed according to these numbers, but such lists have not been found. However, some labels have been encountered with year and number, followed by a locality and "Pérou"; judging by the handwriting (see below), the locality data may have been copied from the unlocated lists. These localities are very precise in the context of Angrand's time, although some of them cannot be traced with modern gazetteers. Other labels are clearly written by a later hand, but sometimes still carry the year or numbers that apparently were on the original sheets. Although no itinerary of Angrand could be traced, it is clear that all localities are trustworthy. In contrast, the labelling of taxon names is more problematic. The taxon names are clearly in different handwritings. Some labels have the taxon name written in pencil and likely in a later hand, some of them have a neat handwriting which seems to be identical with that of the locality data. It is now assumed that this is a handwriting of Morelet, and although it is different from that found in the London collection (Breure & Ablett, 2011: fig. 2E; 2014), there are also similarities (especially the way the abbreviation 'Morlt.' is used). Some unnamed varieties mentioned in Morelet (1863) have been disregarded.

The Brot collection is also worth mentioning here, as some data on its history are known and are detailed elsewhere (Breure & Tardy, 2016). Brot's labels are easily recognisable by his distinct handwriting, but he too had the unpleasant habit of mostly destroying the original labels. Finally, the Lamarck collection has not been integrated in the general collection of the MHNG, and his labels are also very characteristic.

The label photographs of all type specimens are available through the MHNG and in an early version of this manuscript on the author's publication internet site (breure.wordpress.com).

When searching for possible type material it is good practice to compare the label data of the lot to the original published data (e.g., locality, dimensions, collector). In historical collections like these one cannot always expect a perfect match and an interpretation has to be applied with a biohistorical time-frame in mind. Not only the dimensions were less precise than present-day techniques allow, also different ways of measuring may have been applied (Breure & Ablett, 2011: 9-10). Last, but not least, one has to be aware that during the 19th century barter of material was not uncommon among scientists, although this may not have been fully documented or the documentation (e.g., in correspondence) has been lost.

METHODS

When assessing possible type material, the following criteria have been applied: (a) the authorship and the locality fit with the original description (but see above on the differences which may occur between published locality data and those on labels); (b) alleged type material is in accordance with the established understanding of the taxon. In order to fulfill the requirements of article 74 of the International Code of Zoological Nomenclature (ICZN), any lectotype designations herein are to be understood as to have the sole purpose to fix the status of these specimens as the sole name-bearing type of that nominal taxon, to ensure the name's proper and consistent application, even when this is not explicitly done in every single case but abbreviated as "lectotype designation". Lectotypes designated herein are made using the following criteria, in order of preference: (1) the relevant specimen was figured in the original description, or in subsequent revisionary works; (2) if no original figure was published, a specimen was selected that matches as closely as possible the measurements given in the original description.

Within type material, if (some) doubt exist, a further distinction is made between probable and possible type material. The first category has a provenance which makes it likely as type material, even when there is no original label. E.g., in the Brot collection some material was found of taxa described by S. or J. Moricand, the material is marked as coming from Moricand, but there is no evidence that it was really part of the original series

(see remarks on 'original series' before); this material is considered as probable types. In the latter category falls material for which there is more doubt, but nevertheless some evidence exists that could qualify it for type status. E.g., material is from the same collector as mentioned in the original publication, but it is unknown whether the original author saw it or not.

For each taxon the original publication – in which the taxon was proposed – is mentioned, as well as papers in which reference is made to the type material. The type locality is quoted from the original publication in the original wording and language, with clarifying notes between square brackets. The name of the collector, if given in the original paper, is only mentioned (in italics) if it might give a clue about the type status of material present in the collection. The text of the original, or oldest, label is quoted, together with information from subsequent labels if containing information necessary for a correct interpretation. All labels have been photographed and are figured for future historic reference (see before). The original dimensions are quoted, if necessary transferred to mm (one Swiss 'ligne' = 2.2256 mm; see Rowlett 2004). Dimensions of the type specimens have been taken with a digital caliper, using the methods figured by Breure (1974a: figs 2-3); measurements up to 10 mm have an accuracy of 0.1 mm, those above 10 mm are accurate to 0.5 mm. Due to improvements in accuracy of calipers, the measurements given herein are in several cases slightly different from those reported by Breure (1978), and Breure & Eskens (1981). Comparing the current measurements to those quoted from the original publication, one should be aware that the diameter especially may have been measured differently. In the case of syntypes, only the largest specimen has been measured. Under type material the MHNG-INVE registration numbers are given; if specimens from different localities are present, the order of the lots corresponds to the information of the different labels. The number of specimens originally available, if quoted by the original author, are mentioned under remarks. Remarks are further given to describe any individual characteristics of the type specimens or any other details of the type lot. The current systematic position is given, following the generic scheme of Breure (1979) and the familiar arrangement of Breure & Romero (2012).

Abbreviations used for depositories of type material: ANSP, Academy of Natural Sciences, Philadelphia, U.S.A.; MHNG-INVE, Muséum d'histoire naturelle, Department of Invertebrates, Geneva, Switzerland; MCZ, Museum of Comparative Zoology, Harvard University, Cambridge (Mass.), U.S.A.; MNHN, Muséum national d'Histoire naturelle, Paris, France; NHMUK, Natural History Museum, London, U.K.; RBINS, Royal Belgian Institute of Natural Sciences, Brussels, Belgium; SMF, Senckenberg Natur-Museum, Frankfurt am Main, Germany; ZMB, Zoologische Museum des Humboldt Universität, Berlin, Germany.

SYSTEMATICS

Systematic list of taxa encountered in MHNG arranged in generic order

In this systematic list the generic classification has been adapted from Breure (1979), Breure & Schouten (1985), and unpublished data. The family classification follows Breure & Romero (2012), under the notice that some genera are tentatively placed within this framework and ongoing molecular research may alter this classification. Within the family, genus and species level taxa are presented in alphabetical order.

Family Amphibulimidae P. Fischer, 1873

Amplibulima Lamarck, 1805

cucullata Lamarck, 1805.

Dryptus Albers, 1860

pardalis Férussac, 1821.

Gaeotis Shuttleworth, 1854

nigrolineata Shuttleworth, 1854.

Plekocheilus (*Eurytus*) Albers, 1850

pseudopiperatus J. Moricand, 1858.

Family Bothriembryontidae Iredale, 1937

Bothryembryon Pilsbry, 1894

costulatus 'Férussac' Lamarck, 1822; *inflatus* Lamarck, 1822.

Euplacostylus Crosse, 1875

koroensis Garrett, 1872.

Placostylus Beck, 1837

major Gassies, 1871.

Family Bulimulidae Tryon, 1867

Auris Spix, 1827

chrysostoma S. Moricand, 1836; *illheocola* S. Moricand, 1836; *minor* S. Moricand, 1836; *vulgaris* S. Moricand, 1836.

Bostryx Troschel, 1847 sensu Breure, 1979

acromelas Morelet, 1863; *albicolor* Morelet, 1863; *andoicus* Morelet, 1863; *angrandi* Morelet, 1860; *apodemeta* d'Orbigny, 1835; *balsanus* Morelet, 1863; *cactorum* d'Orbigny, 1835; *cercicola* Morelet, 1863; *cuspidatus* Morelet, 1863; *emaciatus* Morelet, 1863; *lesueureanus* Morelet, 1860; *longinquus* Morelet,

1863; *orophilus* Morelet, 1863; *papillatus* Morelet, 1860; *piuranus* Albers, 1854; *radiatus* Morelet, 1863; *rusticellus* Morelet, 1860; *scalaricosta* Morelet, 1860; *serotinus* Morelet, 1860; *spiculatus* Morelet, 1860; *torallyi* d'Orbigny, 1835 [partim]; *tubulatus* Morelet, 1860; *veruculum* Morelet, 1860; *virginalis* Morelet, 1860; *virgultorum* Morelet, 1863.

Bulimulus Leach, 1814

heloica d'Orbigny, 1835; *petenensis* Morelet, 1851.

Oxychona Mörch, 1852

blanchetiana S. Moricand, 1834.

Pseudoxychona Pilsbry, 1930

pileiformis S. Moricand, 1834.

Cochlorina Jan, 1830

aurismuris S. Moricand, 1838.

Drymaeus (*Drymaeus*) Albers, 1850

abyssorum d'Orbigny, 1835; *ceciliae* J. Moricand, 1858; *delphinae* J. Moricand, 1858; *hygrohyla* d'Orbigny, 1835; *mariae* J. Moricand, 1858; *mexicanus* Lamarck, 1822; *poecila* d'Orbigny, 1835; *sachsei* Albers, 1854; *similaris* J. Moricand, 1856; *torallyi* d'Orbigny, 1835 [partim].

Drymaeus (*Mesembrinus*) Albers, 1850

caribaeorum Lamarck, 1822; *fragilis* Lamarck, 1822; *immaculatus* C.B. Adams in Reeve, 1850; *leucomelas* Albers, 1854; *multifasciatus* Lamarck, 1822; *oreades* d'Orbigny, 1835; *polygramma* S. Moricand, 1836; *sisalensis* Morelet, 1849; *tropicalis* Morelet, 1849.

Kuschelenia (*Kuschelenia*) Hylton Scott, 1951

culminea d'Orbigny, 1835; *edwardsi* Morelet, 1863; *tupacii* d'Orbigny, 1835.

Kuschelenia (*Bocourtia*) Rochebrune, 1882

angrandi Morelet, 1860; *ochraceus* Morelet, 1863.

Naesiotus Albers, 1850 sensu Breure, 1979

crepundia d'Orbigny, 1835; *dentritis* Morelet, 1863; *montivaga* d'Orbigny, 1835; *snodgrassi* Dall, 1900; *trichoda* d'Orbigny, 1835; *vestalis* Albers, 1854.

Protoglyptus Pilsbry, 1897

heterogramma S. Moricand, 1836; *longiseta* S. Moricand, 1846.

Rabdotus Albers, 1850

jonesi Clench, 1937

Family Odontostomidae Pilsbry & Vanatta, 1894***Bahiensis* Jousseume, 1877***bahiensis* S. Moricand, 1834.***Biotocus* Salgado & Leme, 1990***tomogeroideus* S. Moricand, 1846.***Burringtonia* Parodiz, 1944***pantragruelina* S. Moricand, 1834; *minor* S. Moricand, 1836.***Plagiodontes* Döring, 1876***patagonica* d'Orbigny, 1835.***Spixia* Pilsbry & Vanatta, 1898***major* d'Orbigny, 1837.***Tomigerus* Spix, 1827***tomigera* S. Moricand, 1836.**Family Orthalicidae Martens in Albers, 1860*****Kara* Strebel, 1910***viridatus* Morelet, 1863; *yanamensis* Morelet, 1863.***Liguus* Montfort, 1810***archeri* Clench, 1934; *barbouri* Clench, 1929; *viridis* Clench, 1934.***Orthalicus* Beck, 1837***phlogera* d'Orbigny, 1835; *zigzag* Lamarck, 1822.***Scholvienia* Strebel, 1910***jaspideus* Morelet, 1863.**Family Simpulopsidae Schileyko, 1999*****Leiostracus* Albers, 1850***cinnamomeolineata* S. Moricand, 1841; *coxeirana* S. Moricand, 1836; *fidaensis* J. Moricand, 1858; *manoelii* S. Moricand, 1841; *viminea* S. Moricand, 1834.***Rhinus* Martens in Albers, 1860***heterotricha* S. Moricand, 1836; *pubescens* S. Moricand, 1846; *velutinohipida* S. Moricand, 1836.***Simpulopsis* (*Eudiotus*) Albers, 1860***boissieri* S. Moricand, 1846; *citrinovitrea* S. Moricand, 1836; *pseudosuccinea* S. Moricand, 1836.***Simpulopsis* (*Simpulopsis*) Beck, 1837***atrovirens* S. Moricand, 1836; *brasiliensis* S. Moricand, 1836; *rufovirens* S. Moricand, 1846.**Alphabetic list of taxa by species name*****Helix abyssorum* d'Orbigny, 1835**

Fig. 45

Helix abyssorum d'Orbigny, 1835: 17. – Breure & Ablett, 2014: 9, figs 27A-C, L1iii.*Bulimus abyssorum* – d'Orbigny, 1837 [1834-1847]: 308, pl. 39 figs 7-8. – Gray, 1854: 21.*Drymaeus abyssorum* – Pilsbry, 1898 [1897-1898]: 192, pl. 37 figs 3-4. – Breure, 1975: 1149, pl. 7 fig. 2 (lectotype designation).*Drymaeus* (*Drymaeus*) *hygrohylaesus* – Miquel, 1989b: 77, fig. 1.**Type locality:** [Bolivia] “provincia Lagunacensi (republica Boliviana)”; see Breure, 1973: 113.**Label:** “Bolivie”, in Moricand's handwriting.**Dimensions:** “Longit. 52 mil., latit. 25 millim.”; figured specimen herein H 46.9 D 24.6, W 5.9.**Type material:** MHNG-INVE-63420, one paratype (ex d'Orbigny, Moricand coll.).**Remarks:** d'Orbigny did not state on how many specimens his description was based. The type series appears to have been split between the MNHN and NHMUK collections (Breure, 1975b; Breure & Ablett, 2014), while one specimen was sent to S. Moricand (likely at an earlier stage before the final split was made). The lectotype is in the MNHN. None of the specimens in London match the original figures, while one of the specimens in Paris is close to the published dimensions. The current systematic position follows Breure & Ablett (2014).**Current systematic position:** Bulimulidae, *Drymaeus* (*Drymaeus*) *abyssorum* (d'Orbigny, 1835).***Bulimus acromelas* Morelet, 1863**

Fig. 92

Bulimus acromelas Morelet, 1863: 202, pl. 11 fig. 1.*Bulimulus* (*Peronaeus*) *acromelas*. – Pilsbry, 1896 [1895-1896]: 144, pl. 45 fig. 31.**Type locality:** [Peru] “dans la vallée d'Ayacucho et de l'Urubamba”.**Label:** “Urubamba” [60378], “Chupan” [60374].**Dimensions:** “Longit. 17; diam. 5 mill.”. Figured specimen H 19.8, D 5.04, W 10.7.**Type material:** MHNG-INVE-60378, three syntypes; 60374, one syntype (Angrand coll.).**Remarks:** Morelet did not state on how many specimens his description was based. One of the specimens from lot 60378 seems to fit his original figure.

Current systematic position: Bulimulidae, *Bostryx acromelas* (Morelet, 1863).

***Bulimus albicolor* Morelet, 1863**

Fig. 69

Bulimus albicolor Morelet, 1863: 199, pl. 11 fig. 9. – Breure & Ablett, 2014: 15, figs 4F, L3vii.

Bulimulus (Peronaeus) albicolor: – Pilsbry, 1896 [1895-1896]: 148, pl. 46 figs 49-50.

Bostryx albicolor: – Breure, 1979: 51.

Type locality: [Peru, Dept. Ayacucho] “Huanta et de la vallée de l’Apurimac”.

Label: “Hauteurs de Huanta”, “Hauteurs de l’Apurimac”, “Huanta”, “Yzcuchaca”, and “Curahuas”.

Dimensions: “Longit 28, diam. 9 mm”; figured specimen herein H 25.4, D 9.68, W 7.4.

Type material: MHNG-INVE-60231, 11 syntypes (Angrand coll.).

Remarks: Morelet did not state on how many specimens his description was based. The largest specimen figured by Morelet is from Curahuas, but is partly damaged at the lip and on the last whorl. Further syntype material is present in the NHMUK and RBINS collections. See also Breure (2011) and Breure & Ablett (2014). The current systematic position follows the synonymization of Richardson (1995: 36) of *Bulimus albicolor*, *B. cercicola* Morelet, 1863, *B. lesueurianus* Morelet, 1860 and *B. orophilus* Morelet, 1863. However, the priority lies with *B. albicolor*, due to a lapsus of Richardson (1995) regarding the publication date of *B. orophilus*; this error was copied by Breure & Ablett (2014).

Current systematic position: Bulimulidae, *Bostryx albicolor* (Morelet, 1860).

***Bulimus andoicus* Morelet, 1863**

Fig. 73

Bulimus andoicus Morelet, 1863: 198, pl. 11 fig. 13. – Breure, 1979: 50. – Breure & Ablett, 2014: 18, figs 10G, L4v.

Bulimulus (Lissoacme) andoicus – Pilsbry, 1896 [1895-1896]: 147, pl. 46 figs 42-44.

Bostryx andoicus – Breure, 1978: 50 (lectotype designation).

Type locality: [Peru] “vallées (..) d’Ayacucho”.

Label: “La laja de Cocharcas”, “La balsa de Cocharcas”, and “Cocharcas”.

Dimensions: “Long. 26-30; diam. 9-10 mill.”; largest figured specimen herein H 23.5, D 8.89, W 6.9.

Type material: MHNG-INVE-60235, nine para-lectotypes (Angrand coll.).

Remarks: Morelet did not state on how many specimens his description was based; he figured three specimens, none of which can be matched with certainty with the Geneva material. The type locality was broadly defined by Morelet and probably also covers adjacent parts of Dept. Apurimac. There are two places called “Cocharcas” in the valley of Río Apurimac, one in Dept. Ayacucho and the other in Dept. Apurimac. Given the range of the dimensions given by Morelet, it is clear that he had a larger type series at hand. There is an additional lot in the NHMUK collection, as described by Breure (1978) and Breure & Ablett (2014), including the lectotype. The current systematic position corresponds to Richardson (1995: 16).

Current systematic position: Bulimulidae, *Bostryx andoicus* (Morelet, 1863).

***Bulimus angrandi* Morelet, 1860**

Fig. 83

Bulimus angrandi Morelet, 1860: 372. – Morelet, 1863: 173, pl. 9 fig. 3.

Bulimulus angrandi. – Pilsbry, 1897 [1897-1898]: 23, pl. 2 fig. 26.

Type locality: [Peru] “[intimâ Peruviii regionae]”; see remarks.

Label: “Huancabelica”.

Dimensions: “Longit. 51; diam. 19 mill.”; figured specimen herein H 49.9, D 22.1, W 7+.

Type material: MHNG-INVE-60610, holotype (Angrand coll.).

Remarks: Morelet (1860) did not mention on how many specimens his description was based. In his 1863 paper he stated “Un seul individu a été recueilli sur les hautes terres d’Huancabelica [Huancavelica] à 3,752 mètres d’altitude”. The specimen found is thus the holotype. The current systematic position follows the classification by Breure & Ablett (2014).

Current systematic position: Bulimulidae, *Kuschelenia (Bocourtia) angrandi* (Morelet, 1860) (comb. n.).

***Helix apodemeta* d’Orbigny, 1835**

Fig. 72

Helix apodemeta d’Orbigny, 1835: 10. – Breure, 1979: 61. – Breure & Ablett, 2014: 22, figs 9A-B, L5vi.

Bulimus apodemetes d’Orbigny, 1837 [1834-1847]: 279, pl. 30 figs 5-8. – Gray, 1854: 16.

Bulimulus (Lissoacme) apodemetus. – Pilsbry, 1896 [1895-1896]: 187, pl. 51 fig. 1-3.

Bulimulus (Bulimulus) apodemetus. – Breure, 1975: 1145.

Type locality: “republica Argentina; republica Boliviana”; see Breure, 1973: 114.

Label: “Bolivie” in Moricand’s handwriting.

Dimensions: “Assez variables; les plus alongés ont, de longueur, 28 millimètres sur 18 de largeur, tandis que les plus courts offrent 23 millimètres de longueur, sur 12 de largeur”; figured specimen herein H 25.5, D 13.5, W 6.3.

Type material: MHNG-INVE-60419, one syntype (ex d’Orbigny, Moricand coll.).

Remarks: d’Orbigny (1835) did not state on how many specimens his description was based. In d’Orbigny (1837 [1834-1847]: 280) the localities were specified as “sur les coteaux du Parna, province d’Entre-rios, près de Feliciano (...) près de San-Lorenzo, province de Santa-Fe. (...) la république de Bolivia (...) des provinces de Valle grande et de la Laguna (...); (...) des plaines de Santa-Cruz de la Sierra, (...) la province de Chiquitos”; see also Breure, 1973. The current systematic position follows Breure & Ablett (2014).

Current systematic position: Bulimulidae, *Bostryx apodemetus* (d’Orbigny, 1835).

Liguus fasciatus archeri Clench, 1934

Fig. 139

Liguus fasciatus archeri Clench, 1934: 106, pl. 7 fig. 5. – Johnson, 2003: 4. – Neubert & Janssen, 2004: 236, pl. 24 fig. 291. – Breure, 2013: 10, figs 19B, 19i.

Type locality: “Mogote de Ramon Millo, Viñales, Pinar del Rio, Cuba”.

Label: “Viñales, Pinar / del Rio, Cuba / A. Archer leg.”.

Dimensions: “Length 55.5 / Width 25.0 (...) mm.”; figured specimen herein H 54.5, D 24.5, W 6+.

Type material: MHNG-INVE-64921, two paratypes (ex MCZ).

Remarks: The holotype is MCZ 80901. The data of the specimens correspond to the original publication. The current systematic position is after Richardson (1993).

Current systematic position: Orthalicidae, *Liguus fasciatus* (Müller, 1774).

Helix (Cochlogena) atrovirens S. Moricand, 1836

Figs 8-10

Helix (Cochlogena) atrovirens S. Moricand, 1836: 416, pl. 2 fig. 1.

Type locality: [Brazil, Bahia] “Portao”.

Label: “Bahia, M. Blanchet 100”, in Moricand’s

handwriting [78487]; “Bahia, Moricand”, in Brot’s handwriting [64624].

Dimensions: “11 millimètres de hauteur et 21 millimètres de largeur”; figured specimen herein H 20.9, D 20.3, W 3.4.

Type material: MHNG-INVE-78487, six syntypes (Moricand coll.); 64624, two probable syntypes (ex Moricand, Brot coll.).

Remarks: Moricand did not state on how many specimens his description was based. The shell height as given by Moricand was probably measured with the aperture down on a surface, and is thus not comparable to the way modern dimensions are given. The specimens in Brot’s collection originate from Moricand and are considered as probable syntypes. The current systematic position follows Simone (2006).

Current systematic position: Simpulopsidae, *Simpulopsis (Simpulopsis) atrovirens* (S. Moricand, 1836).

Helix (Cochlogena) aurismuris S. Moricand, 1838

Fig. 44

Helix (Cochlogena) aurismuris S. Moricand, 1838: 140, pl. 3 figs 1-3. – Neubert & Janssen, 2004: 200, pl. 4 fig. 163.

Type locality: [Brazil] “la fazenda de Palmeirinha, entre Caxoeira et Jacobina, province de Bahia”.

Label: “à la fazenda de la Palmeirinha / prov. de la Jacobina, sur les vieux arbres / (...) M. Blanchet N° 104”, “Brésil, Jacobina, Blanchet”, in Moricand’s handwriting.

Dimensions: “sept lignes dans sa plus grande longueur, et cinq lignes et demie de large” [H 15.75, D 12.4 mm]; figured specimen herein H 31.5, D 17.1, W 6.0.

Type material: MHNG-INVE-60683, 44 syntypes; 60686, 48 syntypes (ex Blanchet, Moricand coll.).

Remarks: Moricand did not state on how many specimens his description was based. His dimensions were given in “lignes”, which equals one Swiss ‘ligne’ = 2.2256 mm; see Rowlett, 2004; the difference between the published and actual dimensions are remarkable. The second lot (60686) has only an original label “N° 104 / *Helix aurismuris* / Nob.”, which may be matched to the other lot where the same number used by Blanchet was found on one of the labels. The “var. alba” as given on one of the labels is an unpublished name. The current systematic position follows Simone (2006).

Current systematic position: Bulimulidae, *Cochlorina aurismuris* (Moricand, 1838).

***Helix (Cochlogena) bahiensis* S. Moricand, 1834**

Figs 113-114

Helix (Cochlogena) bahiensis S. Moricand, 1834: 541, pl. 1 fig. 6.**Type locality:** [Brazil] “le Brésil dans les bois près de Bahia [Salvador]”.**Label:** “Bahia”.**Dimensions:** “Long. 2 cent. Larg. 6 mill.”; figured specimen herein H 18.5, D 5.40, W 6.7.**Type material:** MHNG-INVE-64638, 31 syntypes (ex Blanchet, Moricand coll.).**Remarks:** Moricand did not state on how many specimens his description was based. Most specimens in the lot are largely bleached or soiled, only a few show the typical dark stroke behind the lip. The figured specimen is relatively small, but adult. A database search revealed that four specimens (‘paratypes’ [syntypes]) are MCZ 26217. The current systematic position follows Simone (2006).**Current systematic position:** Odontostomidae, *Bahiensis bahiensis* (S. Moricand, 1834).***Bulimus balsanus* Morelet, 1863**

Fig. 76

Bulimus balsanus Morelet, 1863: 192, pl. 9 fig. 8. – Breure, 1979: 51. – Breure & Ablett, 2014: 27, figs 5B, L7iv. *Bostryx balsanus*. – Breure, 1978: 53 (lectotype designation).**Type locality:** [Peru] “Balsa de Cocharcas”.**Label:** “Abancay”.**Dimensions:** “Long. 19, diam. 8 1/2 mill.”; figured specimen herein H 17.9, D 8.10, W 6.3.**Type material:** MHNG-INVE-60244, two possible paralectotypes (Angrand coll.).**Remarks:** Morelet did not state on how many specimens his description was based; other type material has been found in NHMUK, including the lectotype. The taxon name is written in pencil, and as the locality is somewhat different from the type locality (but in the same region), the material is considered as possible type material only. The current systematic position follows Richardson (1995: 35).**Current systematic position:** Bulimulidae, *Bostryx nigropileatus* (Reeve, 1849).***Liguus crenatus barbouri* Clench, 1929**

Fig. 134

Liguus crenatus barbouri Clench, 1929: 18. – Neubert & Janssen, 2004: 236, pl. 24 fig. 295. – Breure, 2013: 12, figs 19C, 19ii.**Type locality:** “Pinecrest region, central Everglades, Fla. Hammock no. 21 (Farnum number). J.N. Farnum, collector”.**Label:** “Hammock No. 7 / Everglades Pine / Crest region / Florida / J.N. Farnum leg.”.**Dimensions:** “Length 51.5 Width 27 (...) mm.”; figured specimen herein H 43.2, D 22.8, W 6.9.**Type material:** MHNG-INVE-64938, two paratypes (ex MCZ).**Remarks:** In original publication only the holotype is mentioned; MCZ 84527. The type status of this material is, however, not disputed. See also Neubert & Janssen, 2004: 236, who accept Clench’s statement “found in nearly all the hammocks of the Pinecrest region” as sufficient statement to warrant the status of paratypes.**Current systematic position:** Orthalicidae, *Liguus faciatus* (Müller, 1774).***Helix (Helicigona) blanchetiana* S. Moricand, 1834**

Figs 38-39

Helix (Helicigona) blanchetiana S. Moricand, 1834: 539, pl. 1 fig. 3.*Helix (Helicigona) pyramidella* Wagner in Spix. – S. Moricand, 1836: 418.**Type locality:** “le Brésil, aux environs de Bahia”.**Label:** “Bahia”, in Moricand’s handwriting.**Dimensions:** “Long. 15 mill. Larg. 15 mill.”; figured specimen herein H 15.6, D 17.4, W 6.4.**Type material:** MHNG-INVE-60674, 63 syntypes (ex Blanchet, Moricand coll.); see remarks.**Remarks:** Moricand did not state on how many specimens his description was based. In his second paper he placed this taxon in the synonymy of *Helix pyramidella* Wagner in Spix, 1827 (Moricand, 1836: 418), and – on the next page – as one of the several varieties (evidently colour forms) of this species. There he mentioned “Ayant reçu, depuis la publication de mon premier Mémoire (...), un grand nombre de variétés de cette coquille, j’ai reconnu que mon *H. Blanchetiana* rentre dans l’espèce de Spix, dont elle n’est qu’une des variétés que je classe ainsi”. The current lot has 63 specimens altogether, which are thus a mixture of the original lot and shells received later and (partly) considered as varietal forms by Moricand (1836: 419). It is impossible to untangle this lot completely. One shell, which best approaches the original figure of Moricand, is figured herein. The current systematic position follows Simone (2006: 148).**Current systematic position:** Bulimulidae, *Oxychona pyramidella* (Wagner in Spix, 1827).

***Helix (Bulimus) boissieri* S. Moricand, 1846**

Figs 6-7

Helix (Bulimus) boissieri S. Moricand, 1846: 156, pl. 5 figs 24-25. – Neubert & Janssen, 2004: 202, pl. 17 fig. 207.

Type locality: [Brazil] “les environs des Bahia [Salvador]”.

Label: “Bahia”.

Dimensions: “12 à 13 millimètres de haut et 10 de large”; figured specimen herein H 13.1, D 10.6, W 3.8.

Type material: MHNG-INVE-64622, three probable syntypes (ex Moricand, Brot coll.).

Remarks: Moricand did not state on how many specimens his description was based; the material from the Brot collection originates from Moricand, but as it remains unsure whether they belonged to the original series or not, the specimens are regarded as probable type material. The current systematic position follows Richardson (1995).

Current systematic position: Simpulopsidae, *Simpulopsis* (*Eudiotus*) *boissieri* (S. Moricand, 1846).

***Helix (Cochlohydra) brasiliensis* S. Moricand, 1836**

Figs 15-17

Helix (Cochlohydra) brasiliensis S. Moricand, 1836: 416.

Type locality: “[Brazil, Bahia] les forêts de S. Gonsalves”.

Label: “Bahia”, in Moricand’s handwriting.

Dimensions: Not given; figured specimen herein H 14.3, D 17.9, W 3.0.

Type material: MHNG-INVE-78488, nine syntypes (ex Blanchet, Moricand coll.).

Remarks: Moricand did not state on how many specimens his description was based. The label information shows that the material was collected by Blanchet; most specimens are subadults or juveniles. The current systematic position follows Richardson (1995).

Current systematic position: Simpulopsidae, *Simpulopsis* (*Simpulopsis*) *brasiliensis* (S. Moricand, 1836).

***Helix cactorum* d’Orbigny, 1835**

Fig. 74

Helix cactorum d’Orbigny, 1835: 10. – Breure & Ablett, 2014: 36, figs 6D, L10i (lectotype designation).

Bulimus hennahi Gray. – d’Orbigny, 1837 [1834-1847]: 283, pl. 30 figs 3-4.

Type locality: “provincia Tacnacensi (rep. Peruviana)”.

Label: “Pérou”, in Moricand’s handwriting.

Dimensions: “Longit. 25 millim., latit. 15 millim.”; figured specimen herein H 28.8, D 15.8, W 7.0.

Type material: MHNG-INVE-20659, four paralectotypes (ex d’Orbigny, Moricand coll.).

Remarks: These specimens originated from d’Orbigny are considered as type material; the author did not state on how many specimens his description was based. Seven specimens are present in the d’Orbigny collection in NHMUK, of which one was designated lectotype by Breure & Ablett (2014). This taxon has been synonymized with *Bostryx hennahi* (J.E. Gray, 1830) by Richardson (1995: 27) following d’Orbigny (1837 [1834-1847]); however, doubt remains as Breure & Ablett (2014) explained. Only further morphological and molecular research may solve this issue.

Current systematic position: Bulimulidae, *Bostryx hennahi* (J.E. Gray, 1828)?

***Bulimus caribaeorum* Lamarck, 1822**

Figs 56-58

Bulimus caribaeorum Lamarck, 1822: 124. – Mermod, 1951: 734, fig. 83.

Type locality: “les Antilles”.

Label: Only taxon label in Lamarck’s handwriting.

Dimensions: “Longueur, 9 lignes [H = 20.0 mm]”; figured specimen herein H 26.0, D 11.3, W 7.2.

Type material: MHNG-INVE-51169, 6 syntypes (Lamarck coll.).

Remarks: Lamarck mentioned “Mon cabinet”, but did not remark how many specimens he had seen. He referred to *Helix virgulata* Férussac (“Daudeb. Hist. des Moll. no. 396”), of which this taxon is a junior subjective synonym. The material consists of three (sub) adult and three juvenile specimens, without locality data.

Current systematic position: Bulimulidae, *Drymaeus* (*Mesembrinus*) *virgulatus* (Férussac, 1821).

***Bulimus ceciliae* J. Moricand, 1858**

Fig. 49

Bulimus ceciliae J. Moricand, 1858: 452, pl. 14 fig. 4.

Drymaeus strigatus (Pfeiffer). – Pilsbry, 1899: 230, pl. 42 fig. 52.

Type locality: [Peru] “Tarapoto”.

Label: “Tarapoto”, in Moricand’s handwriting.

Dimensions: “Haut., 22 à 17 mill.; long. 10 à 7”; figured specimen herein H 22.3, D 12.3, W 5.5.

Type material: MHNG-INVE-63436, nine syntypes (Moricand coll.).

Remarks: Moricand did not state on how many specimens his description was based. The specimens were collected by M. Porte. Two specimens appear to have been exchanged, and are registered as ‘paratypes’ [syntypes] in MCZ 160197. The current systematic position follows Richardson (1995: 180), but note the different opinion of Breure & Mogollón (2010: 26).

Current systematic position: Bulimulidae, *Drymaeus* (*Drymaeus*) *strigatus* (Sowerby I, 1833).

***Bulimus cercicola* Morelet, 1863**

Fig. 70

Bulimus cercicola Morelet, 1863: 192, pl. 9 fig. 7. – Breure & Ablett, 2014: 40, figs 4G, L12i.

Bulimulus (Lissoacme) cercicola. – Pilsbry, 1896 [1895-1896]: 184, pl. 46 fig. 63.

Bostryx cercicola [sic]. – Breure, 1978: 56. – Breure, 1979: 52.

Type locality: [Peru] “vallées chaudes d’Abancay et d’Acostambo, situées à l’ouest du Cuzco”.

Label: “Abancay”, “Cocharcas”.

Dimensions: “Long. 20; diam. 9 mill.”; figured specimen herein H 19.6, D 8.65, W 6.5.

Type material: MHNG-INVE-60260, one resp. two probable syntypes (Angrand coll.).

Remarks: Morelet did not state on how many specimens his description was based; additional type material is present in NHMUK (Breure & Ablett, 2014). The taxon name is in pencil, by a later hand, therefore the material is considered as probable syntypes; the specimen from Abancay seems to be matching with Morelet’s figure. The current systematic position is as given by Richardson (1995: 36); see above under *Bulimus albicolor* Morelet, 1860.

Current systematic position: Bulimulidae, *Bostryx albicolor* (Morelet, 1860).

Helix (Cochlogena) rhodospira chrysostoma

S. Moricand, 1836

Fig. 88

Helix (Cochlogena) rhodospira var. *β chrysostoma* S. Moricand, 1836: 428.

Type locality: [Brazil] “environs de Bahia [Salvador]”.

Label: “Bahia”, in Moricand’s handwriting.

Dimensions: Not given; figured specimen herein H 56.4, D 34.5, W 4.9.

Type material: MHNG-INVE-60161, five syntypes (Moricand coll.).

Remarks: Moricand did not indicate on how many specimens this variety was based, nor indicated the dimensions. His taxon label reads “*Helix rhodospira* M^d / var. *peristomata lutea*”, which corresponds to the description. The current systematic position follows Richardson (1995).

Current systematic position: Bulimulidae, *Auris melastoma* (Swainson, 1820).

Helix (Cochlogena) cinnamomeolineata

S. Moricand, 1841

Fig. 18

Helix (Cochlogena) cinnamomeolineata S. Moricand, 1841: 60, pl. 4 figs 6-7. – Neubert & Janssen, 2004: 205, pl. 17 fig. 213.

Type locality: [Brazil] “la province de Bahia”.

Label: “Bahia”, in Moricand’s handwriting.

Dimensions: “24 millimètres de hauteur et 11 à 12 dans sa plus grande largeur”; figured specimen herein H 23.2, D 11.2, W 6.7.

Type material: MHNG-INVE-64546, ten syntypes; 64547, 14 syntypes (ex Blanchet, Moricand coll.).

Remarks: Moricand did not mention on how many specimens his description was based, but the range in the diameter of the shell suggests he had several at hand. The taxon label of lot 64546 reads “*Bulimus cinnamomeolineatus* / Moric. / var. *unicolor*”, which is a manuscript name. The current systematic position follows Simone (2006).

Current systematic position: Simpulopsidae, *Leiostracus cinnamomeolineatus* (S. Moricand, 1841).

***Helix (Cochlogena) citrinovitrea* S. Moricand, 1836**

Figs 4-5

Helix (Cochlogena) citrinovitrea S. Moricand, 1836: 436, pl. 2 fig. 19. – Breure, 1979: 135. – Neubert & Janssen, 2004: 205, pl. 17 fig. 208.

Type locality: “[Brazil] aux environs de Bahia”.

Label: “Bahia”, in Moricand’s handwriting [64617]; “Bahia”, in Brot’s handwriting [64616].

Dimensions: “Hauteur, 13 millim.; largeur, 10 millim.”; figured specimen herein H 16.0, D 11.7, W 4.4.

Type material: MHNG-INVE-64617, lectotype and 18 paralectotypes (ex Blanchet, Moricand coll.); 64616, four probable paralectotypes (ex Moricand, Brot coll.).

Remarks: Moricand did not state on how many specimens his description was based. Lot 64617 consists of one adult and many subadult specimens; the second lot (64616) from the Brot collection contains subadults only, but is herein considered as probable type material as uncertainty remains whether the specimens belonged to the original series or not. One specimen was found as ‘paratype’ [syntype] being registered MCZ 26283. Breure (1978: 235) has pointed out the disjunct distribution of this taxon (or, alternatively, the occurrence of morphologically convergent species; see Miquel, 1998); the designation of a lectotype (**design. n.**) should fixate this taxon until further morphological and molecular research has elucidated the relationships within the distribution range.

Current systematic position: Simpulopsidae, *Simpulopsis* (*Eudiotus*) *citrinovitrea* (S. Moricand, 1836).

***Helix* (*Cochlogena*) *coxeirana* S. Moricand, 1836**

Figs 19-21

Helix (*Cochlogena*) *coxeirana* S. Moricand, 1836: 433, pl. 2 figs 7-11. – Neubert & Janssen, 2004: 206, pl. 17 fig. 216.

Helix coxeirana S. Moricand, 1841: 59 [emendation].

Leiostracus (*Leiostracus*) *coxeiranus*. – Köhler, 2007: 154, fig. 140.

Type locality: [Brazil] “Caxoeira, dans la province de Bahia et dans les bois de St.-Gonzales”.

Label: “Bahia”, in Moricand’s handwriting.

Dimensions: “Hauteur, 33 mill.; largeur, 15 mill.”; largest figured specimen herein H 33.0, D 15.2, W 7.2.

Type material: MHNG-INVE-64548, five syntypes; 25410, two syntypes; 25416, one syntype (ex Blanchet, Moricand coll.).

Remarks: Moricand evidently had several specimens at hand, as he recognized five different colour variations (*trizona*, *dizona*, *nigrescens*, *purpurascens*, *unicolor*), partly on the basis of subadult or juvenile specimens. These names are considered as infrasubspecific, were not adopted as valid names before 1985, and are thus unavailable (Lingafelter & Yanega, 2012). Type material of this taxon is also present in ZMB (Köhler, 2007) and SMF (Neubert & Janssen, 2004).

Current systematic position: Simpulopsidae, *Leiostracus coxeiranus* (S. Moricand, 1836).

***Helix crepundia* d’Orbigny, 1835**

Fig. 32

Helix crepundia d’Orbigny, 1835: 14. – Breure & Ablett, 2014: 52, figs 15H-I, L14vi.

Bulimus crepundia. – d’Orbigny, 1837 [1834-1847]: 275, pl. 33 figs 18-19.

Bulimulus crepundia. – Pilsbry, 1897 [1897-1898]: 90, pl. 11 figs 33-34.

Naesiotus crepundia. – Breure, 1975: 1146, pl. 8 fig. 5.

Type locality: “provincia Chiquitensi, republica Boliviana”; see Breure, 1973: 116.

Label: “Chiquito[s]”, in Moricand’s handwriting.

Dimensions: “Latit. 15 millim., long. 10 millim.”, corrected to “Longueur totale, 25 millimètres” in d’Orbigny, 1837 [1834-1847]; figured specimen herein H 22.8, D 9.98, W 7.0.

Type material: MHNG-INVE-60497, three paralectotypes (ex d’Orbigny, Moricand coll.).

Remarks: d’Orbigny did not state on how many specimens his description was based. Type material has been found in the NHMUK (Breure & Ablett, 2014) and MNHN collections; the lectotype is in MNHN (Breure, 1975).

Current systematic position: Bulimulidae, *Naesiotus crepundia* (d’Orbigny, 1835).

***Amphibulima cucullata* Lamarck, 1805**

Figs 140-143

Amphibulima cucullata Lamarck, 1805: 305, pl. 55 figs 1a-c.

Succinea cucullata. – Lamarck, 1822: 134.

Type locality: Not given (see remarks).

Label: “Guadeloupe”, in Lamarck’s (?) handwriting.

Dimensions: “Sa longueur est de 32 millimètres (...), sur 22 millimètres (...) de largeur”; figured specimen herein H 31.0, D 20.2, W 3.7.

Type material: MHNG-INVE-51201, holotype (Lamarck coll.).

Remarks: Lamarck mentioned “Cette coquille est tellement rare, que je ne connois encore que l’individu (...) que je me suis procuré par la voie du commerce. (...) Très-vraisemblablement cette amphibulime n’est point indigène de la France”. It is clear from this text that Lamarck only had one specimen, thus the material found is the holotype. Mermod noted in 1950 “1 échantillon de 31 mm de haut, avec un n° 145 et un “L” (Lamarck indiquait une longueur de 14 lignes = 31.5 mm, et une largeur de 9 lignes et demie = 20.2 mm); l’étiquette s’étant détachée et perdue en 1950, j’ai remis à l’encre de chine sur le même emplacement le n° 145 et refait le L”. He has, however, not mentioned this shell in his papers about the Lamarckian types. On the back of the wooden tablet, holding the pill-box with the specimen, a label is gummed mentioning “Succinea cucullata / Ambrette

capuchon / Guadeloupe". These data correspond to those given by Lamarck (1822).

Current systematic position: Amphibulimidae, *Amphibulima patula* (Bruguière, 1789).

Helix culminea d'Orbigny, 1835

Fig. 106

Helix culminea d'Orbigny, 1835: 13. – Breure, 1979: 88. – Breure & Ablett, 2014: 54, figs 66F-H, L15v.

Bulimus culmineus. – d'Orbigny, 1837 [1834-1847]: 288, pl. 33 figs 8-9.

Bulimulus culmineus. – Pilsbry, 1897 [1897-1898]: 25, pl. 5 figs 74-75.

Scutalus culmineus culmineus. – Breure, 1975: 1143, pl. 1 fig. 3.

Type locality: "culminibus Andesensibus, republica Boliviana" (see remarks).

Label: "Bolivie, sommet des Andes", in Moricand's handwriting.

Dimensions: "Latit. 17 millim., longit. 13 millim."; figured specimen herein H 33.2, D 14.4, W 5.9.

Type material: MHNG-INVE-60575, three paralectotypes (ex d'Orbigny, Moricand coll.).

Remarks: d'Orbigny did not state on how many specimens his description was based, but mentioned two localities (1837 [1834-1847]: 289): "les montagnes de la province de Carangas, à l'ouest d'Oruro, principalement sur celle du 'Pucara', à cinq lieues du bourg de Totora", and "sur toutes les îles et sur toutes les montagnes du lac de Titicaca". The specimens from the latter locality are those in the NHMUK collection (Breure & Ablett, 2014), while those from "Carangas" are in the MNHN collection (Breure, 1975); the lectotype has been selected from the latter collection. Moricand's label seems to be a translation of the locality given in d'Orbigny (1835).

Current systematic position: Bulimulidae, *Kuschelenia* (*Kuschelenia*) *culminea* (d'Orbigny, 1835).

Bulimus cuspidatus Morelet, 1863

Fig. 91

Bulimus cuspidatus Morelet, 1863: 210, pl. 11 fig. 7.

Bulimulus (*Geoceras*) *cuspidatus*. – Pilsbry, 1896 [1895-1896]: 137, pl. 45 fig. 7.

Type locality: [Peru] "Cocabambilla, sur les bords de l'Apurimac, et dans les gorges de Chachapoyas".

Label: "Cocabambilla (Choquequirao) / Pérou".

Dimensions: "Longit. 30, diam. 5 mill."; figured specimen herein H 30.2, D 5.42, W 15.0.

Type material: MHNG-INVE-60377, four syntypes (Angrand coll.).

Remarks: Morelet did not state on how many specimens his description was based. The current systematic position follows Richardson (1995).

Current systematic position: Bulimulidae, *Bostryx cuspidatus* (Morelet, 1863).

Bulimus delphinae J. Moricand, 1858

Fig. 50

Bulimus delphinae J. Moricand, 1858: 452, pl. 14 fig. 3.

Drymaeus strigatus (Pfeiffer). – Pilsbry, 1899: 229, pl. 42 fig. 50.

Type locality: [Peru] "Tarapoto".

Label: "Tarapoto", in Moricand's handwriting.

Dimensions: "Long., 20 à 22 mill.; larg. 8 à 9"; figured specimen herein H 22.4, D 11.6, W 6.0.

Type material: MHNG-INVE-63443, three syntypes (Moricand coll.).

Remarks: Moricand did not state on how many specimens his description was based, but from the range in dimensions it is clear he had multiple specimens at hand. The material was collected by M. Porte. The current systematic position follows Richardson (1995).

Current systematic position: Bulimulidae, *Drymaeus* (*Drymaeus*) *strigatus* (Sowerby I, 1833).

Bulimus dentritus Morelet, 1863

Fig. 33

Bulimus dentritus Morelet, 1863: 206, pl. 9 fig. 5. – Breure, 1979: 62. – Breure & Ablett, 2014: 59, figs 16G, L17ii.

Bulimulus dentritus. – Breure, 1978: 72 (lectotype designation).

Type locality: [Peru, Dept. Cuzco] "près de Huiro, vallée de Santa-Anna".

Label: "Huiro, Val de S' Ana Pérou", "Vilcabamba Pérou", "Pont de Chahuillay (Valle de Santa Ana) Pérou".

Dimensions: "Longit. 20, diam. 8 mill."; figured specimen herein H 20.8, D 7.35, W 7.8.

Type material: MHNG-INVE-60432, lectotype, respectively two and two paralectotypes (Angrand coll.).

Remarks: Morelet did not state on how many specimens his description was based, and part of the material has been found in the NHMUK collection. The material present in MHNG is from various localities, of which one specimen from the type locality was designated lectotype (Breure, 1978). The current

systematic position follows the classification given by Breure & Ablett (2014).

Current systematic position: Bulimulidae, *Naesiotus dentritus* (Morelet, 1863).

***Bulimus edwardsi* Morelet, 1863**

Figs 107-108

Bulimus edwardsi Morelet, 1863: 182, pl. 9 fig. 1. – Breure, 1979: 88. – Breure & Ablett, 2014: 65, figs 67C-D, L19vi.

Bulimulus edwardsi. – Pilsbry, 1897 [1897-1898]: 27, pl. 7 figs 11-13.

Type locality: [Peru, Dept. Huancavelica] “le type (...) Huancabelica; la variété, (...) vallée de Huanta” [Dept. Ayacucho].

Label: “Huancabelica Pérou” [60581, 60584], “Acobamba Pérou” [60584], “Parcos (Altos de Acobamba) Pérou” [60584].

Dimensions: “Longit. 29; diam. 12 mill.”; figured specimen herein H 33.0, D 14.2, W 5.8.

Type material: MHNG-INVE-60581, two (1 + 1) syntypes; 60584, nine (3 + 3 + 3) syntypes (Angrand coll.).

Remarks: Morelet did not mention on how many specimens his description was based. He said this species “habite, dans des conditions différentes, les deux versant[s] de la chaîne de Paucara: le type, du côté d’Huancabelica”; this points to the region east of Huancavelica. One of the specimens from Parcos [60584] seems to fit the left-hand figure in Morelet (1863), one of the specimens from Huancavelica [60581] corresponds to his middle figure. This taxon is currently placed in the genus *Kuschelenia* Hylton Scott, 1951.

Current systematic position: Bulimulidae, *Kuschelenia* (*Kuschelenia*) *culminea edwardsi* (Morelet, 1863).

***Bulimus emaciatus* Morelet, 1863**

Fig. 77

Bulimus emaciatus Morelet, 1863: 201, pl. 11 fig. 10. – Breure, 1979: 53. – Breure & Ablett, 2014: 67, figs 3E, L20iv.

Bulimulus (*Peronaeus*) *emaciatus*. – Pilsbry, 1896 [1895-1896]: 143, pl. 45 figs 27-28.

Bostryx emaciatus. – Breure, 1978: 74, fig. 101 (lectotype designation).

Type locality: [Peru] “les vallées et sur les plateaux de l’intérieur de la Sierra, depuis Ayacucho jusqu’au Cuzco” (see remarks).

Label: “Acobamba Pérou”, “Pucra Pérou”, “Ollan-

taitambo Pérou”, “Andahuailas Pérou”, “Paucara Pérou”, “Cocharcas Pérou”.

Dimensions: “Longit. 22, diam. 5 1/2 mill.”; figured specimen herein H 21.0, D 5.55, W 7.0.

Type material: MHNG-INVE-60408, lectotype and two paralectotypes, respectively ten, three, two, two, and three paralectotypes (Angrand coll.).

Remarks: Breure (1978) upon selecting a lectotype from the MHNG collection, also fixated the type locality to Acobamba according to the label information of the specimen. The other localities are from the same general area, which is still of considerable extension. The current systematic position follows Richardson (1995: 23).

Current systematic position: Bulimulidae, *Bostryx emaciatus* (Morelet, 1863).

***Bulimus fidaensis* J. Moricand, 1858**

Figs 23-24

Bulimus fidaensis J. Moricand, 1858: 451, pl. 14 fig. 1.

Drymaeus fidaensis. – Pilsbry, 1898 [1897-1898]: 232, pl. 41 fig. 21. – Simone, 2006: 137, fig. 450.

Type locality: [Brazil] “Bahia”.

Label: “Bahia”, in Moricand’s handwriting.

Dimensions: “Alt., 30 mill.; diam. 11”; figured specimen herein H 29.6, D 13.5, W 7.0.

Type material: MHNG-INVE-63455, one syntype (Moricand coll.).

Remarks: Moricand did not mention on how many specimens his description was based. Pilsbry suggested that this taxon might belong to the Odontostomidae, genus *Moricandia* Pilsbry & Vanatta, 1898. In a note accompanying the lot, Mermoud wrote in 1937 “Il ne semble pas que ce Bulime soit un *Odontostomus*, ni un ... *Drymaeus* ?”. The protoconch sculpture consists of fine spiral lines and the taxon is now placed in the genus *Leiostracus* Albers, 1850 (**comb. n.**). Moricand’s taxon proves to be a junior subjective synonym of *Bulimus clouei* Pfeiffer, 1857 (**synon. n.**); the lectotype of this species is in the NHMUK (Breure & Ablett, 2015: 26, figs 21i-iii).

Current systematic position: Simpulopsidae, *Leiostracus clouei* (Pfeiffer, 1857) (**comb. n., synonym. n.**).

***Bulimus fragilis* Lamarck, 1822**

Figs 60-61

Bulimus fragilis Lamarck, 1822: 123. – Delessert, 1841: pl. 28 figs 2a-b. – Chenu, 1850 [1842-1854]: pl. 9 figs 2a-b. – Mermoud, 1951: 729, fig. 79.

Type locality: “l’Angleterre”, see remarks.

Label: No locality, but taxon label in Lamarck’s handwriting.

Dimensions: “Longueur, 1 pouce”; figured specimen herein H 28.3, D 13.1, W 6.5.

Type material: MHNG-INVE-51164, five syntypes (Lamarck coll.).

Remarks: Lamarck described this species as British, having it received from Leach with the name *Helix fragilis* Montagu, 1803 (= *Lymnaea stagnalis* L., 1758). Pilsbry (1901 [1901-1902]: 171) was the first to realize that this taxon could be a *Drymaeus* species; he suggested “*Drymaeus stramineus*, *liliaceus*, *virginalis*, or their allies”. Mermod (1951) confirmed the protoconch having the typical grating sculpture of *Drymaeus*. He compared the syntypes with specimens and figures in literature of the first two taxa mentioned by Pilsbry, and found them different from Lamarck’s specimens. He also compared the specimens with Pfeiffer’s description of *Bulimus virginalis* (Pfeiffer, 1856: 46), and suggested that these might be conspecific. However, comparing the specimens with the probable syntypes of Pfeiffer’s taxon (Breure & Ablett, 2014: 207, fig. 24C), I disagree as *Bulimus virginalis* is more elongate and more slender than *B. fragilis*. Since the locality is unclear, it is preferred to keep this taxon as a distinct species until future research sheds more light on the systematic position.

Current systematic position: Bulimulidae, *Drymaeus* (*Mesembrinus*) *fragilis* (Lamarck, 1822).

Helix heloica d’Orbigny, 1835

Fig. 42

Helix heloica d’Orbigny, 1835: 11. – Breure & Ablett, 2014: 87, figs 62E-F, L26v.

Bulimus heloicus. – d’Orbigny, 1837 [1834-1847]: 272, pl. 30 figs 9-11.

Bulimulus (*Lissoacme*) *heloicus*. – Pilsbry, 1896 [1895-1896]: 193, pl. 51 figs 12-13.

Type locality: [Bolivia] “provincia Chiquitensi, republica Boliviana”.

Label: “Chiquito[s]”, label in Moricand’s handwriting.

Dimensions: “Longit. 28 millim., diam. 6 millim.”; figured specimen herein H 22.4, D 10.5, W 5.9.

Type material: MHNG-INVE-79903, one syntype (ex d’Orbigny, Moricand coll.).

Remarks: d’Orbigny (1835) did not state on how many specimens his description was based; the type locality was specified in d’Orbigny, 1837 [1834-1847]: 273 as “près de la Mission de Bibosi, province de Santa-Cruz de la Sierra, et dans la partie orientale de l’immense

forêt (Monte grande) qui sépare Santa-Cruz de la province de Chiquitos, non loin du lieu nommé Potrero de la Cruz”. The locality on the label probably refers to San Javier, Dept. Santa Cruz in Bolivia; see Breure, 1973: 119, 127. The current systematic position follows Breure & Ablett (2014).

Current systematic position: Bulimulidae, *Bulimulus heloicus* (d’Orbigny, 1835).

Helix (*Cochlogena*) *heterogramma* S. Moricand, 1836

Figs 84-85

Helix (*Cochlogena*) *heterogramma* S. Moricand, 1836: 437, pl. 2 figs 15-17.

Bulimulus heterogrammus. – Pilsbry, 1898 [1897-1898]: 321, pl. 26 figs 81-82.

Rhinus heterogrammus. – Simone, 2006: 127, fig. 407.

Type locality: [Brazil, Bahia] “avec la précédente [les grand bois à la Caxoeira]”.

Label: “Brésil, le bois de la Caxoeira”, in Moricand’s handwriting.

Dimensions: “Longueur, 13 mill.; largeur, 5 mill.”; figured specimen herein H 12.5, D 5.95, W 6.2.

Type material: MHNG-INVE-64598, four syntypes (Moricand coll.).

Remarks: Moricand did not mention on how many specimens his description was based. Pilsbry (1898 [1897-1898]) placed this taxon under the heading ‘Species of uncertain subgeneric position’, and suggested it might possibly be a *Protoglyptus* species. Simone (2006) classified this taxon as a *Rhinus* species, without further explanation. Upon examination of the type material, the protoconch sculpture appears consisting of axial riblets, spaced 1-2 times the width of the riblets, with very fine spiral striation in between the riblets. This places this taxon in the genus *Protoglyptus* Pilsbry, 1897.

Current systematic position: Bulimulidae, *Protoglyptus heterogrammus* (S. Moricand, 1836) (comb. n.).

Helix (*Cochlogena*) *heterotricha* S. Moricand, 1836

Fig. 26

Helix (*Cochlogena*) *heterotricha* S. Moricand, 1836: 430, pl. 2 figs 5-6.

Rhinus heterotricha. – Köhler, 2007: 154, fig. 143.

Type locality: Not given [Brazil, Bahia].

Label: “Bahia”, in Moricand’s handwriting.

Dimensions: “Long. 55 mil., larg. 32 mil.”; figured specimen herein H 53.4, D 32.3, W 7.2.

Type material: MHNG-INVE-64602, six syntypes (ex Blanchet, Moricand coll.).

Remarks: Moricand did not mention on how many specimens his description was based. The current systematic position follows Simone (2006).

Current systematic position: Simpulopsidae, *Rhinus heterotricha* (S. Moricand, 1836).

Helix hygrohyla d'Orbigny, 1835

Fig. 46

Helix hygrohyla d'Orbigny, 1835: 18. – Breure & Ablett, 2014: 91, figs 27D-F, L27iv.

Bulimus hygrohyla d'Orbigny, 1837 [1834-1847]: 311, pl. 40 figs 3-5. – Gray, 1854: 21.

Drymaeus hygrohyla d'Orbigny, 1837 [1834-1847]: 311, pl. 40 figs 3-5. – Pilsbry, 1898 [1897-1898]: 194, pl. 37 figs 9-10. – Breure, 1975: 1151.

Drymaeus (Drymaeus) hygrohyla d'Orbigny, 1837 [1834-1847]: 311, pl. 40 figs 3-5. – Miquel 1989b: 77, figs 3-4.

Type locality: “provincia Chiquitensi (republica Boliviana)”.

Label: “Chiquito[s]”, in Moricand’s handwriting.

Dimensions: “Longit. 41 millim., latit. 19 millim.”; figured specimen herein H 43.9, D 19.5, W 7.3.

Type material: MHNG-INVE-63469, four paralectotypes (ex d'Orbigny, Moricand coll.).

Remarks: d'Orbigny did not state on how many specimens his description was based; additional type specimens are present in NHMUK and MNHN collections; the lectotype is housed in the latter collection. The current systematic position follows the synonymisation of this taxon with *Helix abyssorum* d'Orbigny, 1835, by Miquel (1989b: 77); see also Breure & Ablett (2014).

Current systematic position: Bulimulidae, *Drymaeus (Drymaeus) abyssorum* (d'Orbigny, 1835).

Helix (Cochlogena) rhodospira illheocola

S. Moricand, 1836

Fig. 89

Helix (Cochlogena) rhodospira var. *illheocola* S. Moricand, 1836: 428.

Type locality: [Brazil, Bahia] “Illheos”.

Label: “Brésil aux Illheos”, “Bahia”, “Brésil Illheos”; all in Moricand’s handwriting.

Dimensions: Not given”; figured specimen herein H 66.7, D 37.5, W 4.9.

Type material: MHNG-INVE-60171, six syntypes (ex Blanchet, Moricand coll.); 60169, two probable syntypes (ex Moricand, Brot coll.).

Remarks: Moricand did not state on how many specimens his description was based, nor did he mention the dimensions of this taxon. Richardson (1995: 9) gave an erroneous reference to “1837 Moricand, Mem. Soc. Phys. Hist. Nat. Geneve 8: pl. 2 fig. 4”. The current systematic position is according Simone (2006).

Current systematic position: Bulimulidae, *Auris illheocolus* (S. Moricand, 1836).

Bulimus immaculatus C.B. Adams in Reeve, 1850

Fig. 62

Bulimus immaculatus C.B. Adams in Reeve, 1850 [1848-1850]: pl. 85 fig. 631. – Breure, 1979: 120 (lectotype designation). – Neubert & Janssen, 2004: 213, pl. 16 fig. 188. – Breure & Ablett, 2014: 93, figs 17L-M, L28iii.

Drymaeus (Mesembrinus) immaculatus. – Breure & Eskens, 1981: 73, pl. 7 fig. 4.

Type locality: “Jamaica”.

Label: “Jamaica”.

Dimensions: Not given; figured specimen herein H 29.7, D 13.9, W 6.4.

Type material: MHNG-INVE-64442, three paralectotypes (ex Adams, Moricand coll.).

Remarks: The specimen was described and figured on the basis of specimens received from Adams with a manuscript name. Breure (1979) selected as lectotype the specimen that best fitted the figure of Reeve. The current systematic position is according Rosenberg & Muratov (2005).

Current systematic position: Bulimulidae, *Drymaeus (Mesembrinus) immaculatus* (C.B. Adams in Reeve, 1850).

Bulimus inflatus Lamarck, 1822

Fig. 30

Bulimus inflatus Lamarck, 1822: 122 (not Olivier, 1801). – Delessert, 1841: pl. 28 figs 1a-b. – Chenu, 1850 [1842-1854]: pl. 9 figs 1a-b. – Mermoud, 1951: 728, fig. 78. – Kendrick & Wilson, 1975: 307, pl. 3 figs 4a-b. – Breure & Whisson, 2012: 66, fig. 5C.

Helix costulatus ‘Férussac’ Lamarck, 1822: 122 (in synonymy).

Type locality: [Australia] “la Nouvelle-Hollande”.

Label: “?”, taxon label in Lamarck’s handwriting.

Dimensions: “Longueur, près d’un pouce [H ~ 27 mm]”; figured specimen herein H 26.0, D 15.6, W 5.4.

Type material: MHNG-INVE-51162 five syntypes (Lamarck coll.).

Remarks: Lamarck did not state on how many specimens his description was based. Kendrick & Wilson (1975) discussed at length the status of these two taxa and the confusion arisen in previous literature with *Bothriembryon onslowi* (Cox, 1864). They convincingly showed that both *Bulimus inflatus* and *Helix costulatus* share the same type material, and the latter name is applicable for this taxon.

Current systematic position: Bothriembryontidae, *Bothriembryon costulatus* (Lamarck, 1822).

***Bulimus jaspideus* Morelet, 1863**

Fig. 129

Bulimus jaspideus Morelet, 1863: 180, pl. 7 fig. 7.

Strophocheilus jaspideus. – Pilsbry, 1895 [1895-1896]: 61, pl. 29 fig. 61.

Type locality: [Peru] “de la vallée tempérée de Yucáí”, and “sur les murs des jardins, aux environs de Huancabelica”.

Label: “Huancabelica”, “Huillabamba”, “Yucáí”, “Pau-cara”.

Dimensions: “Longit. 37-47; diam. 18-21 mill.”; figured specimen herein H 47.2, D 21.4, W 6.9.

Type material: MHNG-INVE-60211, two syntypes; 60210, four (1 + 2 + 1) syntypes (all Angrand coll.).

Remarks: Morelet did not mention on how many specimens his description was based; judged from the range in dimensions he had multiple specimens at hand. He said the larger specimens were found in the surroundings of Huancavelica. The current systematic position is based on unpublished data.

Current systematic position: Orthalicidae, *Scholvienia jaspidea* (Morelet, 1863).

***Bulimulus dealbatus jonesi* Clench, 1937**

Fig. 31

Bulimulus dealbatus jonesi Clench, 1937: 18. – Johnson, 2003: 14.

Type locality: [U.S.A.] “2 miles north of West Greene, Greene Co., Alabama”.

Label: “2 miles west [sic] of West Greene, Greene Co., Alabama”.

Dimensions: “Length 19.1, width 9.9 (...) mm”; figured specimen herein H 18.1, D 10.4, W 6.1.

Type material: MHNG-INVE-60529, six paratypes (ex MCZ).

Remarks: Although it is not clear how many specimens were in the type series, Clench (1937: 19) mentioned for

the dimensions “average of five paratypes”, which were said to be from the same locality and deposited in the MCZ collection [MCZ 75036]. The current systematic position follows Richardson (1995).

Current systematic position: Bulimulidae, *Rabdotus dealbatus* (Say, 1821).

***Bulimus koroensis* Garrett, 1872**

Fig. 29

Bulimus koroensis Garrett, 1872: 236, pl. 18 fig. 9.

Type locality: [Fiji] “Koro Isl., Viti Isles”.

Label: “Koro (Fidji)”; see remarks.

Dimensions: “Length 53 mill.; diam., 18 mill.”; figured specimen herein H 47.7, D 18.4, W 5.1.

Type material: MHNG-INVE-64767, three probable paralectotypes (ex Garrett).

Remarks: Garrett did not state on how many specimens his description was based, but said type material was in “Coll. Garrett and Phila. Acad.”. The latter is ANSP 8397 (lectotype) and 450748 (five paralectotypes). From the lot in Geneva only a modern label exists, stating the material originates from Garrett. It is therefore considered as probable type material.

Current systematic position: Bothriembryontidae, *Euplacostylus koroensis* (Garrett, 1872).

***Bulimus lesueureanus* Morelet, 1860**

Fig. 68

Bulimus lesueureanus Morelet, 1860: 374. – Morelet, 1863: 200, pl. 9 fig. 4. – Breure, 1979: 55. – Breure & Ablett, 2014: 107, figs 1G-H, L33vi.

Bulimulus (Peronaeus) lusueureanus. – Pilsbry, 1896 [1895-1896]: 149, pl. 46 fig. 45.

Bostryx lesueureanus. – Breure, 1978: 97.

Type locality: “[in intimâ Peruvii regione]” (see remarks).

Label: “Pomacocha, Pérou”, “La Laja de Coeharcas”.

Dimensions: “Longit. 21; diam. 7 mill.”; figured specimen herein H 21.1, D 7.88, W 6.2.

Type material: MHNG-INVE-60380, three (1 + 2) syntypes (Angrand coll.).

Remarks: Morelet did not state on how many specimens his description was based. The type locality was specified in Morelet (1863: 201) “Il provient de Pomacoecha et Coeharcas”. The current systematic position follows Richardson (1995: 37), but see above under *Bulimus albicolor* Morelet, 1860.

Current systematic position: Bulimulidae, *Bostryx albicolor* (Morelet, 1860).

***Bulimus leucomelas* Albers, 1854**
Fig. 65

Bulimus leucomelas Albers, 1854b: 219.

Drymaeus (*Mesembrinus*) *leucomelas*. – Köhler, 2007: 151, fig. 122 (lectotype designation).

Type locality: “Columbia [Peru] ad fluvium Maranhon”.

Label: “Columbia”, in Moricand’s handwriting.

Dimensions: “Long. 29, diam. vix 10 mill.”; figured specimen herein H 25.9, D 9.12, W 7.3.

Type material: MHNG-INVE-64455, one paralectotype (ex Albers, Moricand coll.).

Remarks: Albers did not state on how many specimens his description was based; the lectotype is in the ZMB (Köhler, 2007). The current systematic position follows this author.

Current systematic position: Bulimulidae, *Drymaeus* (*Mesembrinus*) *leucomelas* (Albers, 1854).

***Bulimus longinquus* Morelet, 1863**
Figs 100-101

Bulimus longinquus Morelet, 1863: 195, pl. 11 fig. 2. – Breure, 1979: 55. – Breure & Ablett, 2014: 112, figs 11A, L35iii.

Bostryx longinquus. – Breure, 1978: 98 (lectotype designation).

Type locality: [Peru, Dept. Cuzco] “Limatambo, Ollantaitambo, Yucay et Piré”.

Label: “Ollantaitambo Pérou”, “Limatambo Pérou”, “Yucaï (valle de Urubamba) Pérou”, “Piré (Altos del Valle Silque) Pérou” [60284], “Yucaï (valle de Urubamba) Pérou”, “Piré (Altos del Valle Silque) Pérou” [60283].

Dimensions: “Longit. 31, diam. 12 mill.”; figured specimen herein H 29.9, D 13.4, W 7.1.

Type material: MHNG-INVE-60283, lectotype and one paralectotype; 60284, 20 (6 + 3 + 6 + 5) paralectotypes (Angrand coll.).

Remarks: Morelet did not mention on how many specimens his description was based. Breure (1978) designated a specimen from Yucay, figured by Morelet, as lectotype. Other paralectotypes are present in the NHMUK collection (Breure & Ablett, 2014).

Current systematic position: Bulimulidae, *Bostryx longinquus* (Morelet, 1863).

***Helix* (*Bulimus*) *longiseta* S. Moricand, 1846**
Figs 86-87

Helix (*Bulimus*) *longiseta* S. Moricand, 1846: 156, pl. 5 figs 18-20.

Bulimulus longiseta. – Pilsbry, 1897 [1897-1898]: 77, pl. 13 figs 22-23.

Type locality: [Brazil] “la province de Bahia”.

Label: “Bahia”, in Moricand’s handwriting.

Dimensions: “7 millimètres de haut et autant de large”; figured specimen herein H 6.91, D 5.72, W 4.0.

Type material: MHNG-INVE-64605, six syntypes (ex Blanchet, Moricand coll.).

Remarks: Moricand did not mention on how many specimens his description was based. The material found are likely not adults. Protoconch sculpture consisting of oblique axial riblets, interstices ca. four times as wide as the riblets, becoming zigzag on lower 1/4 part of the first whorl; very fine spiral striae in between the riblets. Tentatively placed in the genus *Protoplytus* Pilsbry, 1897.

Current systematic position: Bulimulidae, *Protoplytus longisetus* (S. Moricand, 1846) (comb. n.).

***Helix* (*Cochlogena*) *manoelii* S. Moricand, 1841**
Fig. 25

Helix (*Cochlogena*) *manoelii* S. Moricand, 1841: 59, pl. 4 figs 4-5. – Neubert & Janssen, 2004: 216, pl. 17 fig. 214.

Type locality: [Brazil] “la province de Bahia”.

Label: “Bahia”, in Moricand’s handwriting [91244]; “Bahia”, in Brot’s handwriting [64551].

Dimensions: “20 à 24 millimètres de hauteur sur 12 de largeur”; figured specimen herein H 22.5, D 11.3, W 6.5.

Type material: MHNG-INVE-91244, 12 syntypes (ex Blanchet, Moricand coll.); 64551, eight probable syntypes (ex Moricand, Brot coll.).

Remarks: Moricand did not state on how many specimens his description was based. Material from the Brot collection is considered as probable type material, as it may or may not have been part of the original series. The current systematic position follows Simone (2006).

Current systematic position: Simpulopsidae, *Leiostracus manoelii* (S. Moricand, 1841).

***Bulimus duplex major* Gassies, 1871**
Fig. 135

Bulimus duplex [var. β] *major* Gassies, 1871: 64.

Type locality: “Île Acméne, Nouvelle-Calédonie (Marie)”.

Label: “N. Cal.”; “Nou, Caled.”, in Brot’s handwriting.

Dimensions: “Long. 77 mill.; diam. maj. 45”; figured specimen herein H 88.0, D 47.2, W 6.7.

Type material: MHNG-INVE-64837, one possible syntype (ex Marie, Brot coll.).

Remarks: Gassies did not state on how many specimens his description was based, but described this taxon on the basis of material collected by Marie. According to Neubert *et al.* (2009: 86) the taxon was based on an undetermined number of specimens, and they showed that Gassies’ name is a junior homonym of *Bulimus hindsii major* L. Pfeiffer, 1841. The specimen in the Brot collection is, according to the label in Brot’s hand, originating from E. Marie. It is, however, possible that this material reached Geneva via Crosse, as the original label seems to bear his handwriting. The specimen is thus considered as possible type material. The current systematic position follows Neubert *et al.* (2009).

Current systematic position: Bothriembryontidae, *Placostylus porphyrostomus monackensis* (Crosse, 1888).

Pupa spixii major d’Orbigny, 1837

Fig. 122

Helix spixii [var.] *major* d’Orbigny, 1835: 21 [nomen nudum].

Pupa spixii [var. α] *major* d’Orbigny, 1837 [1834-1847]: 320. –

Breure & Ablett, 2012: 25, figs 22A-E, 22i.

Pupa spixii (d’Orbigny). – Gray, 1854: 23 [partim].

Spixia striata (Spix). – Breure, 1975: 1158 [partim].

Type locality: “... pays habité par les Guarayos, au sein des forêts humides des frontières nord de la province de Chiquitos (république de Bolivie), et dans la province de Corrientes (république Argentine), en un bois voisin de la rivière de Santa-Lucia, au lieu dit ‘Pasto reito’”; see Breure, 1973: 122.

Label: “Corrientes”, in Moricand’s handwriting.

Dimensions: “Long. var. A, 35 millim., (...) Lat. var. A, 12 millim.”; figured specimen herein H 34.6, D 9.66, W 12.1.

Type material: MHNG-INVE-64662, 11 paralectotypes (ex d’Orbigny, Moricand coll.).

Remarks: In d’Orbigny (1835) only the name of this taxon is mentioned, together with a locality, thus it was invalidly published. The first valid publication is in d’Orbigny, 1837 [1834-1847], where only a brief description was given but no figures of the ventral view of the shell (only a side view of a living snail). There is no explicit mentioning of “var. *major*” on the label,

as d’Orbigny has done with varieties of other taxa; the only link are the localities quoted in his original paper. The lectotype is in NHMUK (Breure & Ablett, 2012).

Current systematic position: Odontostomidae, *Spixia striata* (Spix, 1827).

Bulimus mariae J. Moricand, 1858

Figs 47-48

Bulimus mariae J. Moricand, 1858: 453, pl. 14 fig. 5.

Type locality: [Peru] “Tarapoto”.

Label: “Tarapoto”, in Moricand’s handwriting.

Dimensions: “Haut., 24 mill.; larg. 9 à 10”; figured specimen herein H 23.3, D 12.3, W 6.0.

Type material: MHNG-INVE-64389, seven syntypes (Moricand coll.).

Remarks: Moricand did not state on how many specimens his description was based. One additional specimen was found in the MCZ collection database, registered as MCZ 160196 (‘paratype’ [syntype]). The name is a junior homonym of *Bulimus mariae* Albers, 1850. In literature (e.g. Richardson, 1995), this taxon has been considered a junior synonym of *Bulimus strigatus* Pfeiffer, 1841, but this taxon should be ascribed to Sowerby I. Compared to that species this taxon has a narrower aperture, and the suture is more strongly ascending in front. The classification of earlier authors, however, is tentatively retained until further studies have shown the variation within this species.

Current systematic position: Bulimulidae, *Drymaeus* (*Drymaeus*) *strigatus* (Sowerby I, 1833).

Bulimus mexicanus Lamarck, 1822

Fig. 54

Bulimus mexicanus Lamarck, 1822: 123. – Delessert, 1841: pl. 27 figs 9a-b. – Chenu, 1850 [1842-1854]: pl. 8 figs 1a-b. – Mermod, 1951: 730, fig. 80.

Type locality: “le Mexique”, see remarks.

Label: No locality given.

Dimensions: “Longueur, 14 lignes [H = 31.1 mm]”; figured specimen herein H 30.9, D 17.2, W 6.2.

Type material: MHNG-INVE-51166, two syntypes (Lamarck coll.).

Remarks: Lamarck used material collected by Humboldt and Bonpland, but did not state how many specimens he examined. Mermod (1951) confirmed that the protoconch sculpture is characteristic for *Drymaeus* and repeated the opinion of earlier authors (e.g. Pilsbry, 1898 [1897-1898]: 292) that this taxon is in fact a species

from northern Peru. The material has no taxon label in Lamarck's hand, but the type status of the material is not disputed herein.

Current systematic position: Bulimulidae, *Drymaeus* (*Drymaeus*) *mexicanus* (Lamarck, 1822).

Helix (*Cochlogena*) *maximiliana minor*
S. Moricand, 1836
Fig. 90

Helix (*Cochlogena*) *maximiliana* [var. γ] *minor* S. Moricand, 1836: 431. – S. Moricand, 1838: 141, pl. 3 fig. 4.

Type locality: [Brazil, Bahia] “Illheos”.

Label: “Bahia”, in Moricand's handwriting.

Dimensions: Not given; figured specimen herein H 38.2, D 25.6, W 4.5.

Type material: MHNG-INVE-60152, 11 syntypes (ex Blanchet, Moricand coll.).

Remarks: Moricand did not state on how many specimens his description was based. He wrote “bouche blanc”, but three specimens have a black lip. The specimen figured by Moricand (1838: pl. 4 fig. 3; a living specimen, seen from the left-hand side) is difficult to recognize among the specimens, because the colors have faded, and none of the specimens with a white lip show the notch visible in Moricand's figure. The current systematic position is according Richardson (1995).

Current systematic position: Bulimulidae, *Auris egregia* (Jay, 1836).

Helix (*Cochlodina*) *pantagruelina minor*
S. Moricand, 1836
Fig. 124

Helix (*Cochlodina*) *pantagruelina* [var. γ] *minor* S. Moricand, 1836: 441.

Type locality: Not given.

Label: “Bahia”, in Moricand's handwriting.

Dimensions: “45 millimètres de hauteur”; figured specimen herein H 45.1, D 18.7, W 6+.

Type material: MHNG-INVE-64698, three syntypes (ex Blanchet, Moricand coll.).

Remarks: See the note under the nominate taxon below. This is the only variety of which the name is available from the three which Moricand mentioned in his paper. The specimen that matches his dimensions is figured now, its top is damaged. The current systematic position follows Simone (2006).

Current systematic position: Odontostomidae, *Burrintonia pantagruelina* (S. Moricand, 1834).

Helix montivaga d'Orbigny, 1835
Fig. 34

Helix montivaga d'Orbigny, 1835: 14. – Breure & Ablett, 2014: 124, figs 15J, L38iv.

Bulimus montivagus d'Orbigny, 1837 [1834-1847]: 275, pl. 34 figs 1-3. – Gray, 1854: 15.

Naesiotus montivagus. – Breure, 1975: 1146.

Type locality: [Bolivia] “provincia Lagunensis (república Boliviana)”; see remarks.

Label: “Rep. Argentina” in Moricand's handwriting.

Dimensions: “Longit. 16 millim.; latit. 7 millim.”; figured specimen herein H 19.4, D 7.20, W 7.4.

Type material: MHNG-INVE-60505, two paralectotypes (ex d'Orbigny, Moricand coll.).

Remarks: Orbigny (1835) originally also mentioned “et provincia Entre-Rios (republica Argentina)” as type locality. The type locality was later restricted to “Bolivia, Dept. Santa Cruz” by Breure (1975: 1146); see also Breure, 1973. Miquel (1989a: 62) concluded that this species does not occur in Argentina.

Current systematic position: Bulimulidae, *Naesiotus montivagus* (d'Orbigny, 1835).

Bulimus multifasciatus Lamarck, 1822
Figs 66-67

Bulimus multifasciatus Lamarck, 1822: 123. – Delessert, 1841: pl. 28 figs 3a-c. – Chenu, 1850 [1842-1854]: pl. 9 figs 3a-b. – Mermoud, 1951: 732, fig. 81.

Type locality: “les Antilles”.

Label: No locality.

Dimensions: “1 pouce de longueur [H = 26.7 mm]”; figured specimen herein H 25.7, D 12.0, W 5+.

Type material: MHNG-INVE-51167, one syntype (Lamarck coll.).

Remarks: Lamarck did not state on how many specimens his description was based. Although there is no taxon label in Lamarck's hand, the type status of the specimen is not disputed herein.

Current systematic position: Bulimulidae, *Drymaeus* (*Mesembrinus*) *multifasciatus* (Lamarck, 1822).

***Gaeotis nigrolineata* Shuttleworth, 1854**

Figs 111-112

Gaeotis nigrolineata Shuttleworth, 1854: 35. – Breure, 1974b: 239, figs 4, 8, pl. 1 figs 1-3 (lectotype designation). – Neubert & Gosteli, 2003: 39, pl. 7 fig. 3.

Type locality: [Puerto Rico] “Sierra de Luquillo”.

Label: “Luquillo / Portorico”.

Dimensions: “Diam. maj. 12; Alt. circa 3 1/2 mill.”; figured specimen herein H 6.0, D 9.0, W 2.0.

Type material: MHNG-INVE-64746, three possible paralectotypes (ex Shuttleworth, Brot coll.).

Remarks: Shuttleworth did not state on how many specimens his description was based; the lectotype is in the NMBE (Neubert & Gosteli, 2003). One of the labels accompanying the specimens shows two handwritings, of which the lower left text (in brownish ink) is in the handwriting of Brot, the other is not in Shuttleworth’s hand (E. Neubert, pers. commun.), but as the material is ex Shuttleworth it is here considered as possible type material.

Current systematic position: Amphibulimidae, *Gaeotis nigrolineata* Shuttleworth, 1854.

***Bulimus ochraceus* Morelet, 1863**

Fig. 109

Bulimus ochraceus Morelet, 1863: 176, pl. 7 fig. 6. – Breure, 1979: 86. – Breure & Ablett, 2014: 138, figs 71E-F, 71J, L42viii.

Scutalus (Vermiculatus) ochraceus. – Breure, 1978: 180 (lectotype designation).

Type locality: [Peru, Dept. Cuzco] “à Soraï et à Salcantai”.

Label: “Soraï Pérou”, “Salcantai Pérou”.

Dimensions: “Long. 37-40; diam. 17-18 mill.”; figured specimen herein H 38.5, D 20.9, W 4.5.

Type material: MHNG-INVE-60615, lectotype and seven (1 + 2 + 4) paralectotypes (Angrand coll.).

Remarks: Morelet remarked that this taxon occurs in the lower part of ‘puna brava’, i.e. at high elevations. The type locality is thus at the slopes of Nevado Saleantay and near Soray, which is at ca. 4100 m elevation, in Dept. Cuzco. Breure (1978) selected one of the specimens from Salcantay as the lectotype. The current systematic position follows Breure & Ablett (2014).

Current systematic position: Bulimulidae, *Kuschelenia (Bocourtia) ochracea* (Morelet, 1863).

***Helix oreades* d’Orbigny, 1835**

Fig. 59

Helix oreades d’Orbigny, 1835: 11. – Breure & Ablett, 2014: 140, figs 54L-M, L43ii.

Bulimus oreades. – d’Orbigny, 1837 [1834-1847]: 270, pl. 31 figs 11-12. – Gray, 1854: 15.

Mesembrinus oreades. – Simone, 2006: 146, fig. 489.

Type locality: “provincia Corrientes (republica Argentina)”.

Label: “Corrientes”, in Moricand’s handwriting.

Dimensions: “Longit. 32 millim.; latit. 7 millim.”; figured specimen herein H 31.4, D 14.3, W 5.9.

Type material: MHNG-INVE-64483, one paralectotype (Moricand coll.).

Remarks: The type locality has been specified in d’Orbigny, 1837 [1834-1847]: 270 as “la rive sud du Rio de Santa-Lucia, dans les environs de San-Roque” (see Breure, 1973: 120, fig. 8). According to Miquel (1989b: 76) this taxon does not occur in Argentina, but in Brasil. The lectotype is in the NHMUK (see Breure & Ablett, 2014, also for other comments).

Current systematic position: Bulimulidae, *Drymaeus (Mesembrinus) oreades* (d’Orbigny, 1835).

***Bulimus orophilus* Morelet, 1863**

Fig. 71

Bulimus orophilus Morelet, 1863: 189, pl. 9 fig. 6. – Breure, 1979: 56. – Breure & Ablett, 2014: 140, figs 4H, L43iii.

Bostryx orophilus. – Breure, 1978: 107 (lectotype designation).

Type locality: “les vallées tempérées des plateaux de Cuzco; (..) notablement à Talavera, Silque, Incahuasi et Mollepata” (restricted to Peru, Dept. Cuzco, Prov. Anta, Distr. Limatambo, Mollepata; Breure, 1978).

Label: “Incahuasi Pérou”, “Mollepata Pérou”, “Silque Pérou”, “Andahuaylillas Pérou”, “Curahuasi Pérou”, “Talavera Pérou”, “Quiquijana Pérou”.

Dimensions: “Long. 22; diam. 9 mill.”; figured specimen herein H 23.3, D 9.78, W 6.9.

Type material: MHNG-INVE-60289, 21 (3 + 4 + 2 + 5 + 3 + 2 + 2) paralectotypes (Angrand coll.).

Remarks: Morelet did not state on how many specimens his description was based. The lectotype was chosen by Breure (1978) from the material labelled ‘Mollepata’. Additional type material is in NHMUK (Breure & Ablett, 2014). The current systematic position follows Richardson (1995: 37), but see above under *Bulimus albicolor* Morelet, 1860.

Current systematic position: Bulimulidae, *Bostryx albicolor* (Morelet, 1860).

***Helix (Cochlodina) pantagruelina* S. Moricand, 1834**

Fig. 123

Helix (Cochlodina) pantagruelina S. Moricand, 1834: 542, pl. 1 fig. 7. – S. Moricand, 1836: 440. – Breure, 2013: 37, figs 30F, 30iii.

Type locality: [Brazil] “le Brésil”.

Label: “Bahia”, in Moricand’s handwriting.

Dimensions: “Long 6 cent. 5 mill.”; figured specimen herein H 52.9, D 21.2, W 7.3.

Type material: MHNG-INVE-64695, 15 syntypes; 64700, two syntypes (ex Blanchet, Moricand coll.).

Remarks: Moricand wrote in his original paper “les deux [individus] que j’ai reçus moi-même”, suggesting that this lot is the original series. Compare to Moricand (1836: 440), where he wrote “je n’avais alors qu’un seul exemplaire à ma disposition”, which seems in contrast with his earlier text; however, from his text it is clear that some errors were made during type setting of his original paper, which he corrected in his 1836 paper. If there originally was only one specimen it may either have been lost or mixed up with the others, which were apparently received at a later stage. Evidence for this is the distinction of three varieties in his second paper, of which only one (γ *minor*) is an available name (see above). The labels, possibly in J. Moricand’s hand, show descriptive terms (*peristomate albo*, *peristomate carneo*), which have not been used by S. Moricand in his description. As the lot cannot be untangled all specimens are considered as syntypes. Three syntypes (‘paratypes’) were found in the database of MCZ, registered as MCZ 26235.

Current systematic position: Odontostomidae, *Burringtonia pantagruelina* (S. Moricand, 1834).

***Bulimus papillatus* Morelet, 1860**

Fig. 79

Bulimus papillatus Morelet, 1860: 372. – Morelet, 1863: 186, pl. 8 fig. 2. – Breure & Ablett, 2014: 143, figs 8E, L44ii. *Neopetraeus papillatus*. – Pilsbry, 1898 [1897-1898]: 169, pl. 31 figs 28-29.

Type locality: [Peru] “[intimâ Peruviii regionae]”; see remarks.

Label: “Vilcas Huaman”, “Parcos”, “Pucra (Plateau de Vilcas Huaman)”, “Hauteurs de la Laja de Cocharcas” [60388], “La laja de Cocharcas” [60387, 60390].

Dimensions: “Longit. 25; diam. 14 mill.”; figured specimen herein H 24.8, D 20.2, W 5.7.

Type material: MHNG-INVE-60387, three syntypes; 60388, 23 (1 + 4 + 4 + 14) syntypes; 60390, three syntypes (all Angrand coll.).

Remarks: Morelet did not mention on how many specimens his description was based. In his 1863 paper he specified the type locality as “notamment à Pucra”. Some taxon labels are presumably in Morelet’s hand. The current systematic position follows Breure & Ablett (2014), who listed additional type material in the London collection.

Current systematic position: Bulimulidae, *Bostryx papillatus* (Morelet, 1860).

***Helix (Cochlostyla) pardalis* Férussac, 1821**

Fig. 138

Helix (Cochlostyla) pardalis Férussac, 1821 in Férussac & Deshayes, 1819-1851: pl. 112 figs 7-8 [6 April 1821]. – Férussac, 1821 [1821-1822]: 48 [26 May 1821].

Type locality: “?”.

Label: Not given; see remarks.

Dimensions: Not given; figured specimen herein H 70.2, D 34.3, W 5.0.

Type material: MHNG-INVE-60142, one syntype (ex Férussac).

Remarks: Férussac mentioned in his Tableau systématique (1821: 48) “No. 332 pardalis, nobis, pl. CXII, fig. 7, 8 / Habit. ? Collect. D. Sollier de la Touche”, which explains why this specimen was associated with type material by P. Godet. Férussac did not state on how many specimens his description was based, so this specimen is a syntype. The dates of publication of both works by Férussac have been taken from Welter Sehultes (2015). The label has clearly been written in a later hand, and the locality “Venezuela ?” has probably been added on account of the literature.

Current systematic position: Amphibulimidae, *Dryptus pardalis* (Férussac, 1821).

***Helix patagonica* d’Orbigny, 1835**

Fig. 126

Helix patagonica d’Orbigny, 1835: 22. – Breure & Ablett, 2012: 31, figs 25E-G, 25ii.

Bulimus patagonicus. – d’Orbigny, 1837 [1834-1847]: 321, pl. 41 figs 17-18.

Plagiodontes patagonicus (d’Orbigny). – Breure, 1975: 1159, pl. 5 fig. 4, pl. 10 fig. 4.

Type locality: [Argentina] “Patagonia”.

Label: “Patagonie”, in Moricand’s handwriting.

Dimensions: “Longit. 22 1/2 millim., latit. 11 millim.”; figured specimen H 22.2, D 11.1, W 6.5.

Type material: MHNG-INVE-64708, five paralectotypes (ex d’Orbigny, Moricand coll.).

Remarks: d'Orbigny did not state on how many specimens his description was based. The lectotype is in the Paris museum (Breure, 1975), paralectotypes are in London (Breure & Ablett, 2012).

Current systematic position: Odontostomidae, *Plagiodontes patagonicus* (d'Orbigny, 1835).

***Bulimus petenensis* Morelet, 1851**

Fig. 43

Bulimus petenensis Morelet, 1851: 10. – Breure, 1979: 64 (lectotype designation). – Neubert & Janssen, 2004: 222, pl. 10 fig. 108. – Breure & Ablett, 2014: 149, figs 63M-N, L45vii.

Bulimulus unicolor petenensis. – Breure, 1978: 149.

Bulimulus unicolor (Sowerby I). – Thompson, 2011: 107.

Type locality: [Guatemala] “campos Petenensis”.

Label: “Savanes du Peten”, in Moricand’s handwriting.

Dimensions: “Longit. 19.–Diam. 8”; figured specimen herein H 16.2, D 7.91, W 5.9.

Type material: MHNG-INVE-60291, two paralectotypes (ex Morelet).

Remarks: Morelet did not mention on how many specimens his description was based. According to the label, Moricand received the material in 1850 from Morelet. One of the specimens is broken. The lectotype is in the NHMUK collection. The current systematic position follows Thompson (2011).

Current systematic position: Bulimulidae, *Bulimulus unicolor* (Sowerby I, 1833).

***Helix phlogera* d'Orbigny, 1835**

Fig. 130

Helix phlogera d'Orbigny, 1835: 8. – Breure & Ablett, 2015: 44, figs 13iii-iv, L15iii.

Bulimus phlogerus. – d'Orbigny, 1837 [1834-1847]: 259, pl. 29 figs 6-8 [text 30 March 1838]. – Gray, 1854: 12.

Type locality: “provincia Chiquitensi (republica Boliviana)”.

Label: “Chiquitos”, in Moricand’s handwriting.

Dimensions: “Longit. 55 millim.; latit. 24 millim.”. Figured specimen H 47.5, D 24.2, W 5.9.

Type material: MHNG-INVE-64982, two syntypes (ex d'Orbigny, Moricand coll.).

Remarks: d'Orbigny (1835) did not state on how many specimens his description was based. In d'Orbigny (1838 [1834-1847]: 260) the locality was specified as “environs des Missions de San-Xavier et de Concepcion”; see Breure, 1973. Of the material found,

none of the shells corresponds exactly to d'Orbigny's figure. Additional material is in NHMUK (Breure & Ablett, 2015). The current systematic position is according to Richardson (1993: 108).

Current systematic position: Orthalicidae, *Orthalicus phlogerus* (d'Orbigny, 1835).

***Helix (Helicigona) pileiformis* S. Moricand, 1836**

Figs 40-41

Helix (Helicigona) pileiformis S. Moricand, 1836: 420, pl. 2 fig. 2.

Type locality: [Brazil, Bahia] “Illheos”.

Label: “Illheos”, in Moricand’s handwriting.

Dimensions: Not given; figured specimen herein H 19.5, D 12.8, W 7.1.

Type material: MHNG-INVE-64567, four syntypes (ex Blanchet, Moricand coll.).

Remarks: Moricand wrote: “Cette espèce, que je crois fort rare, puisque je n'en ai reçu qu'un seul individu”, suggesting that the original series was only one shell; Moricand did not mention the dimensions of his specimen. The present four specimens are accompanied by a label that confirms the material originating from Blanchet and locality Illheos. Therefore it is likely that either the original specimen was mixed with three specimens later received from Blanchet, or the holotype was lost and all specimens were subsequently sent by Blanchet. As this cannot be determined ex post, and the source and locality of the material are not disputed herein, these specimens are now considered as syntypes. The current systematic position follows Simone (2006).

Current systematic position: Bulimulidae, *Pseudoxychona pileiformis* (S. Moricand, 1834).

***Bulimus piuranus* Albers, 1854**

Fig. 81

Bulimus piuranus Albers, 1854a: 31.

Bostryx piuranus. – Köhler, 2007: 133, fig. 30 (lectotype designation).

Type locality: “Peruvia septentrionalis, prope oppidum Piura”.

Label: “Columbie”, in Moricand’s handwriting.

Dimensions: “Long. 20, diam. 9 millim.”; figured specimen herein H 23.7, D 10.9, W 7.0.

Type material: MHNG-INVE-60294, one paralectotype (ex Albers, Moricand coll.).

Remarks: Albers did not mention on how many specimens his description was based. Köhler (2007)

located 11 specimens in the ZMB collection, from which he designated one as the lectotype.

Current systematic position: Bulimulidae, *Bostryx piuranus* (Albers, 1854).

***Helix poecila* d'Orbigny, 1835**

Fig. 53

Helix poecila d'Orbigny, 1835: 11. – Breure & Ablett, 2014: 153, figs 45M-N, L47iii.

Bulimus poecilus. – d'Orbigny, 1837 [1834-1847]: 268, pl. 21 figs 1-10. – Gray, 1854: 15.

Drymaeus cf. *draparnaudi* (Pfeiffer). – Breure, 1975: 1150, pl. 8 fig. 2 (partim).

Drymaeus poecilus. – Breure, 1975: 1152 (partim).

Type locality: “provincia Chiquitensi (republica Boliviana)”; see remarks.

Label: “Chiquitos”, in Moricand’s handwriting.

Dimensions: “Longit 22 1/2 mil.; latit. a 15 ad 16 millim.”; figured specimen herein H 26.8, D 13.0, W 6.0.

Type material: MHNG-INVE-63506, five paratypes (ex d'Orbigny, Moricand coll.).

Remarks: In d'Orbigny (1837 [1834-1847]) the type locality is specified for two varieties, var. *major* and var. *minor*. Var. *major* was found especially at “la porte de Tasajos et du bourg de Pampa grande”. Var. *minor* occurs in the forests bordering the “Rio grande”, the forests bordering “Rio de Tacabaca, entre San-Juan et Santo-Corazon de Chiquitos et aux environs de cette première Mission [San Juan]”. See also Breure (1973). The lot in MHNG belongs to the latter mentioned. All material belongs to the same species, contrasting the findings of Breure (1975) for the material in the MNHN; additional specimens are in the NHMUK (Breure & Ablett, 2014).

Current systematic position: Bulimulidae, *Drymaeus* (*Drymaeus*) *poecilus* (d'Orbigny, 1835).

***Helix (Cochlogena) polygramma* S. Moricand, 1836**

Figs 136-137

Helix (Cochlogena) polygramma S. Moricand, 1836: 436, pl. 2 figs 12-14.

Type locality: [Brazil, Bahia] “les grand bois à Caxoeira”.

Label: “Bahia, Caxoeira”, in Moricand’s handwriting.

Dimensions: “Hauteur, 13 mill.; largeur, 5 mill.”; figured specimen herein H 14.0, D 5.83, W 5.8.

Type material: MHNG-INVE-64561, four syntypes (ex Blanchet, Moricand coll.).

Remarks: Moricand did not state on how many specimens his description was based. This species was hitherto considered as belonging to *Leiostracus* Albers, 1850 (Simone, 2006: 123), but this small-sized species with its fine, axial riblets which superficially appear as colour streaks, and the dark patch around the umbilicus is here placed in the genus *Drymaeus* Albers, 1850.

Current systematic position: Bulimulidae, *Drymaeus* (*Mesembrinus*) *polygrammus* (S. Moricand, 1834) (**comb. n.**).

***Bulimus pseudopiperatus* J. Moricand, 1858**

Figs 1-3

Bulimus pseudopiperatus J. Moricand, 1858: 451, pl. 14 fig. 2.

Type locality: [Peru] “Moyobamba”.

Label: “Moyobamba”, in Moricand’s handwriting.

Dimensions: “Haut., 40 mill.; larg., 30”; figured specimen herein H 59.1, D 33.4, W 5.8.

Type material: MHNG-INVE-55493, one syntype (Moricand coll.).

Remarks: Moricand did not state on how many specimens his description was based; the specimen found corresponds to his figure.

Current systematic position: Amphibulimidae, *Plekocheilus* (*Eurytus*) *pseudopiperatus* (J. Moricand, 1858).

Helix (Cochlogena) pseudosuccinea

S. Moricand, 1836

Fig. 11

Helix (Cochlogena) pseudosuccinea S. Moricand, 1836: 435, pl. 2 fig. 18. – Neubert & Janssen, 2004: 225, pl. 17 fig. 206.

Type locality: [Brazil] “environs de Bahia [Salvador]”.

Label: “Bahia”, in Moricand’s handwriting.

Dimensions: “Hauteur, 21 mill.; largeur, 10 mill.”; figured specimen herein H 21.8, D 9.81, W 4.9.

Type material: MHNG-INVE-64619, 42 (2 + 7 + 33) syntypes (ex Blanchet, Moricand coll.).

Remarks: Moricand did not state on how many specimens his description was based, but from his text it is clear that at first he had only a juvenile shell, and only later he received “un très grand nombre d’individus”, but remarked “pendant deux années, M. Blanchet n’eût pas rencontré quelques adultes”. Three lots in MHNG are considered as type material, one without any label and consisting of 33 mostly subadult specimens, one with only a taxon label and consisting of seven subadult and juvenile specimens, and one lot of two specimens

with a locality and taxon label. One additional syntype is present in the MCZ collection, registered as MCZ 26190 as 'paratype' [syntype]. The current systematic position follows Simone (2006).

Current systematic position: Simpulopsidae, *Simpulopsis* (*Eudioptus*) *pseudosuccinea* (S. Moricand, 1836).

***Helix (Bulimus) pubescens* S. Moricand, 1846**

Fig. 27

Helix (Bulimus) pubescens S. Moricand, 1846: 157, pl. 5 figs 21-23. – Neubert & Janssen, 2004: 225, pl. 17 fig. 205.

Type locality: [Brazil] “les environs de Bahia [Salvador]”.

Label: “Bahia”, in Moricand’s handwriting.

Dimensions: “16 à 17 millimètres de long et 7 à 8 de large”; figured specimen herein H 15.6, D 7.25, W 6.2.

Type material: MHNG-INVE-64606, 68 syntypes (ex Blanchet, Moricand coll.).

Remarks: Moricand did not state on how many specimens his description was based. According to the label the material was received from Blanchet in 1843. The current systematic position follows Simone (2006).

Current systematic position: Simpulopsidae, *Rhinus pubescens* (S. Moricand, 1846).

***Bulimus radiatus* Morelet, 1863**

Fig. 78

Bulimus radiatus Morelet, 1863: 188, pl. 9 fig. 2. – Breure, 1979: 57 (lectotype designation). – Breure & Ablett, 2014: 164, figs 12A-C, L51ii.

Bulimulus angrandianus Pilsbry, 1897 [1897-1898]: 19 (new name for *Bulimus radiatus* Morelet not Bruguière, 1789).

Type locality: [Peru, Dept. Junín/Cuzco] “la vallée de Jauja et des pentes du Cuzco”.

Label: “Agama, Pérou”, “Cuzco, Pérou”, “Huayocachi Pérou”, “Mito Pérou”.

Dimensions: “Longit. 24-29; diam. 10-10 1/2 mill.”; figured specimen herein H 23.9, D 11.4, W 6.5.

Type material: MHNG-INVE-60295, eight (1 + 1 + 2 + 1 + 3) paralectotypes (Angrand coll.).

Remarks: According to Pilsbry (1897-1898: 19) this taxon is a junior homonym of *Bulimus radiatus* Bruguière, 1789. Richardson (1995: 35, 167) placed this taxon in the synonymy of *Bulimus nigropileatus* Reeve, 1849, which is not endorsed. It is clear from the dimensions quoted by Morelet, that he had ample

material at hand. The localities on the labels are from central (Mito) and southern Peru (Cuzco); the other localities could not be located. The mixture of material from two widely separated regions in Peru, and the lack of a precise location for the type material, makes this taxon a nomen inquirendum as likely a species complex or morphologically convergent species are involved. The lectotype is in NHMUK collection (Breure & Ablett, 2014).

Current systematic position: Bulimulidae, *Bostryx angrandianus* (Pilsbry, 1897). Nomen inquirendum.

***Helix (Succinea) rufovirens* S. Moricand, 1846**

Figs 12-14

Helix (Succinea) rufovirens S. Moricand, 1846: 147, pl. 5 fig. 4. – Breure, 1979: 134. – Neubert & Janssen, 2004: 227, pl. 17 fig. 209.

Type locality: [Brazil] “le Brésil, dans la province de Bahia”.

Label: “Bahia”, in Moricand’s handwriting.

Dimensions: Not given. Figured specimen H 11.8, D 14.2, W 3.3.

Type material: MHNG-INVE-64632, 50+ syntypes; 78493, 13 syntypes (ex Blanchet, Moricand coll.).

Remarks: Moricand did not state on how many specimens his description was based. Although he did not provide precise dimensions, he stated in the comparison with other species (S. Moricand, 1846: 148) “*S. rufovirens* (...) à quatre tours et par sa hauteur égale à sa largeur”. The type material covers the whole range from juvenile to adult. The current systematic position follows Simone (2006).

Current systematic position: Simpulopsidae, *Simpulopsis* (*Simpulopsis*) *rufovirens* (S. Moricand, 1846).

***Bulimus rusticellus* Morelet, 1860**

Fig. 80

Bulimus rusticellus Morelet, 1860: 373. – Morelet, 1863: 185, pl. 8 fig. 5. – Breure & Ablett, 2014: 172, figs 7D, L52ix.

Bulimulus (Lissoacme) rusticellus. – Pilsbry, 1896 [1895-1896]: 170, pl. 49 figs 23-24.

Type locality: [Peru] “[intimâ Peruviii regionae]”; see remarks.

Label: “Ruines de Tunumarca. Pérou”, “Orcoluna Pérou”, “Ruines de Sausa Pérou”, “Pomacocha Pérou”, taxon label presumably in Morelet’s handwriting.

Dimensions: “Longit. 20; diam 10 1/1 mill.”; figured specimen herein H 20.1, D 13.6, W 5.0.

Type material: MHNG-INVE-60304, nine (2 + 2 + 3 + 2) paralectotypes (Angrand coll.).

Remarks: Morelet (1860) did not state on how many specimens his description was based. In Morelet (1863) the locality is specified as “la vallée de Jauja”. The lectotype is in the NHMUK (Breure & Ablett, 2014). The current systematic position is according to Richardson (1995).

Current systematic position: Bulimulidae, *Bostryx rusticellus* (Morelet, 1860).

***Bulimus sachsei* Albers, 1854**

Fig. 52

Bulimus sachsei Albers, 1854a: 30. – Breure, 1979: 114.

Drymaeus sachsei. – Köhler, 2007: 148, fig. 108 (lectotype designation).

Type locality: “Columbia australi [Peru] ad fluvium Maranhon”.

Label: “Columbie”, in Moricand’s handwriting.

Dimensions: “Long. 30, diam. 12 millim.”. Figured specimen H 31.9, D 13.9, W 6.8.

Type material: MHNG-INVE-63524, one paralectotype (ex Albers, Moricand coll.).

Remarks: Albers did not state on how many specimens his description was based. Köhler (2007) designated a specimen from the ZMB as lectotype. The current systematic position follows his classification.

Current systematic position: Bulimulidae, *Drymaeus (Drymaeus) sachsei* (Albers, 1854).

***Bulimus scabrellus* ‘Anthony’ Dohrn, 1882**

Fig. 125

Bulimus scabrellus ‘Anthony’ Dohrn, 1882: 106, pl. 3 fig. 14 [sic, 9] (in synonymy). – Neubert & Janssen, 2004: 228, pl. 19 fig. 249.

Type locality: “Brasilien”.

Label: “Brésil”, in Moricand’s handwriting.

Dimensions: Not given; figured specimen herein H 19.7, D 6.86, W 8.4.

Type material: MHNG-INVE-64686, two specimens (ex Anthony, Moricand coll.).

Remarks: The material was sent directly by Anthony and, analogous to Neubert & Janssen (2004), is here considered as belonging to the original series, of which Anthony sent one or more specimen(s) with his manuscript to Dohrn.

Current systematic position: Odontostomidae, *Cyclodontina inflata* (Wagner in Spix, 1827).

***Bulimus scalaricosta* Morelet, 1860**

Fig. 98

Bulimus scalaricosta Morelet, 1860: 375. – Morelet, 1863: 205, pl. 11 fig. 8. – Breure, 1979: 58. – Breure & Ablett, 2014: 174, figs 1E, L53iv.

Bostryx tubulatus scalaricostus. – Breure, 1978: 132 (lectotype designation).

Type locality: [Peru] “[intimâ Peruviii regionae]”; see remarks.

Label: “Chincheras Pérou”, “Andamarca Pérou”.

Dimensions: “Longit. 15; diam. 5 mill.”. Figured specimen H 15.5, D 5.08, W 7.2.

Type material: MHNG-INVE-60405, 20+ paralectotypes; 60407, five paralectotypes (Angrand coll.).

Remarks: Morelet (1860) did not state on how many specimens his description was based. In Morelet (1863) the locality is specified as “sur le plateau d’Andamarca”; as there are several places with that name in the region where Angrand travelled, it is not clear which one was meant. The lectotype, from Yucay in the Vilcanota valley, is in the NHMUK collection (Breure & Ablett, 2014).

Current systematic position: Bulimulidae, *Bostryx tubulatus scalaricostus* (Morelet, 1860).

***Bulimus serotinus* Morelet, 1860**

Fig. 82

Bulimus serotinus Morelet, 1860: 374. – Morelet, 1863: 207, pl. 11 fig. 5. – Breure, 1979: 58 (lectotype designation). – Breure & Ablett, 2014: 178, figs 12E, L54v.

Type locality: [Peru] “[intimâ Peruviii regionae]”; see remarks.

Label: “Andahuaylas. Pérou”, “Chupan Pérou”, “Chahullay (valle de Sta Ana) Pérou”, “Abancay Pérou”.

Dimensions: “Longit. 26; diam. 10 1/2 mil.”; figured specimen herein H 29.8, D 12.4, W 7.7.

Type material: MHNG-INVE-60313, 16 (2 + 1 + 12 + 1) paralectotypes (Angrand coll.).

Remarks: Morelet (1860) did not state on how many specimens his description was based. In Morelet (1863) the locality is specified as “notamment à Andahuaylas, Abancay et Chupan”. The lectotype is in the NHMUK (Breure & Ablett, 2014). The current systematic position follows Richardson (1995: 44).

Current systematic position: Bulimulidae, *Bostryx serotinus* (Morelet, 1860).

***Bulimus similaris* J. Moricand, 1856**

Fig. 51

Bulimus similaris J. Moricand, 1856: 177, pl. 6 fig. 8.*Drymaeus similaris*. – Pilsbry, 1898 [1897-1898]: 233, pl. 42 fig. 60.**Type locality:** [Peru] “Moyobamba”.**Label:** “Moyobamba”, in Moricand’s handwriting.**Dimensions:** “Haut. 23 à 25 mill. / Larg. 10 mill.”. Figured specimen H 23.6, D 12.8, W 5.3.**Type material:** MHNG-INVE-63531, seven syntypes (Moricand coll.).**Remarks:** Moricand did not state on how many specimens his description was based. According to the label the material was collected by M. Porte. The current systematic position accords with Richardson (1995).**Current systematic position:** Bulimulidae, *Drymaeus* (*Drymaeus*) *similaris* (J. Moricand, 1856).***Bulimus sisalensis* Morelet, 1849**

Fig. 63

Bulimus sisalensis Morelet, 1849: 9. – Breure, 1975b: 1152 (lectotype designation). – Breure, 1979: 123. – Neubert & Janssen, 2004: 230, pl. 16 fig. 193. – Breure & Ablett, 2014: 180, figs 24G, L55iii.**Type locality:** “cum precedente [circa Sisalensem pagum Yucatanorum]”.**Label:** “Yucatan, près de Sisal”, in Moricand’s handwriting.**Dimensions:** “Longit. 24.–Diam. 9 1/2”; figured specimen herein H 21.4, D 9.83, W 6.3.**Type material:** MHNG-INVE-64471, one paralectotype (ex Morelet, Moricand coll.).**Remarks:** Morelet did not state on how many specimens his description was based; additional type material is in NHMUK (lectotype; Breure & Ablett, 2014) and SMF (Neubert & Janssen, 2004). The current systematic position follows Thompson (2011: 120).**Current systematic position:** Bulimulidae, *Drymaeus* (*Mesembrinus*) *multilineatus* (Say, 1825).***Bulimulus snodgrassi* Dall, 1900**

Fig. 35

Bulimulus snodgrassi Dall, 1900: 90, pl. 8 fig. 2. – Pilsbry, 1901 [1901-1902]: 150, pl. 24 fig. 2.**Type locality:** [Galápagos Islands] “Hood Island”.**Label:** “Galapagos Ins.”.**Dimensions:** “Alt. of shell 17, diam. of shell 6 [mm]”; figured specimen herein H 17.3, D 7.29, W 7.1.**Type material:** MHNG-INVE-60518, two paratypes (Schade coll.).**Remarks:** Dall said he had “numerous specimens” at hand during the description. The material comes from the collection of F.H. Schade (1904-1977), formerly of Villarica, Paraguay. There is no original label providing evidence that this material once belonged to the original series, hence some doubt remains on the type status.**Current systematic position:** Bulimulidae, *Naesiotus snodgrassi* (Dall, 1900).***Bulimus spiculatus* Morelet, 1860**

Fig. 93

Bulimus spiculatus Morelet, 1860: 375. – Morelet, 1863: 203, pl. 11 fig. 3. – Breure, 1979: 58. – Breure & Ablett, 2014: 183, figs 3B-C, L56iii.*Bulimulus* (*Peronaeus*) *spiculatus*. – Pilsbry, 1896 [1895-1896]: 144, pl. 45 fig. 29.*Bostryx spiculatus spiculatus*. – Breure, 1978: 122 (lectotype designation).**Type locality:** [Peru] “[intimâ Peruviii regionae]”; see remarks.**Label:** “Ollantaïtambo Pérou”, “Moyabamba Pérou”, “Urquillos Pérou”.**Dimensions:** “Longit. 20; diam. 5 mill.”; figured specimen herein H 23.3, D 4.97, W 11.2.**Type material:** MHNG-INVE-60411, three paralectotypes; 60414, five paralectotypes; 60415, five paralectotypes (all Angrand coll.).**Remarks:** Morelet (1860) did not state on how many specimens his description was based. In Morelet (1863) the locality is specified as “la vallée d’Ollantaïtambo”. The lectotype is in the NHMUK (Breure & Ablett, 2014).**Current systematic position:** Bulimulidae, *Bostryx spiculatus spiculatus* (Morelet, 1860).***Helix* (*Cochlodonta*) *tomigera* S. Moricand, 1836**

Figs 115-117

Helix (*Cochlodonta*) *tomigera* S. Moricand, 1836: 439. – S. Moricand, 1841: 152, pl. 5 figs 13-15.**Type locality:** [Brazil, Bahia] “les bois de la Caxoeira”.**Label:** “Brésil”, in Moricand’s handwriting.**Dimensions:** Not given; figured specimen herein H 10.1, D 13.5, W 4.2.

Type material: MHNG-INVE-64717, one syntype (Moricand coll.).

Remarks: Moricand (1836) wrote “le très-petit nombre d’individus que M. Blanchet en a pu recueillir”, without specifying the number of specimens. The current systematic position follows Simone (2006).

Current systematic position: Odontostomidae, *Tomigerus clausus* (Spix, 1827).

***Helix tomigeroides* S. Moricand, 1846**

Figs 118-121

Helix tomigeroides S. Moricand, 1846: 153, pl. 5 figs 10-12.

Type locality: [Brazil] “la province de Bahia”.

Label: “Bahia”, in Moricand’s handwriting.

Dimensions: Not given; figured specimen herein H 11.4, D 12.1, W 4.7.

Type material: MHNG-INVE-64718, 16 syntypes (Moricand coll.).

Remarks: Moricand did not state on how many specimens his description was based. The current systematic position follows Simone (2006).

Current systematic position: Odontostomidae, *Biotocus turbinatus* (Pfeiffer, 1845).

***Helix torallyi* d’Orbigny, 1835**

Figs 55, 97

Helix torallyi d’Orbigny, 1835: 11. – Breure & Ablett, 2014: 194, figs 11D, L60iii.

Bulimus torallyi d’Orbigny, 1837: 285, pl. 32 figs 1-4.

Bulimulus (?) *torallyi* (d’Orbigny). – Breure, 1975: 1146, pl. 8 fig. 4 [corresponding to d’Orbigny, 1837: pl. 32 figs 1-2].

Drymaeus cf. *draparnaudi* (Pfeiffer). – Breure, 1975: 1150, pl. 8 fig. 2 [corresponding to d’Orbigny, 1837: pl. 32 figs 3-4].

Bostryx torallyi (d’Orbigny). – Breure, 1979: 59.

Type locality: “provincia Valle-Grande, republica Boliviana” [Bolivia, Dept. Santa Cruz, Prov. Valle Grande].

Label: “Bolivia”; in Moricand’s handwriting.

Dimensions: “Long. 31 millim.; lat. 11 millim.”; largest figured specimen herein H 27.9, D 10.5, W 7.5.

Type material: MHNG-INVE-60326, two paralectotypes (ex d’Orbigny, Moricand coll.).

Remarks: Breure (1975) found type material in the Paris museum and concluded that it belonged to two different species, one lot corresponding to pl. 32 figs 1-2 (this is d’Orbigny’s var. A) and one lot to figs 3-4 (var.

B). The material found in MHNG also belongs to two different taxa, in contrast to the material in the NHMUK (Breure & Ablett, 2014). The lectotype is in the MHNH.

Current systematic position: Bulimulidae, *Bostryx torallyi* (d’Orbigny, 1835) and *Drymaeus* (*Drymaeus*) *draparnaudi* (Pfeiffer, 1847).

***Helix trichoda* d’Orbigny, 1835**

Fig. 36

Helix trichoda d’Orbigny, 1835: 12. – Breure & Ablett, 2014: 195, figs 16D-F, L60vi (lectotype designation).

Bulimus trichodes. – d’Orbigny, 1837 [1834-1847]: 277, pl. 33 figs 1-5 [19 June / 7 Aug 1837; text 23 April 1838]. – Gray, 1854: 16.

Naesiotus trichodes. – Breure, 1975: 1147.

Type locality: “provincia Santa Cruz de la Sierra (republica Boliviana)”.

Label: “Bolivia”, in Moricand’s handwriting.

Dimensions: “Longit. 20 millim.; latit. 10 millim.”; figured specimen herein H 18.5, D 8.04, W 7.7.

Type material: MHNG-INVE-60513, one paralectotype (ex d’Orbigny, Moricand coll.).

Remarks: d’Orbigny (1837 [1834-1847]: 277) specified this species to be found in gardens of Santa Cruz de la Sierra city. Breure (1975) mentioned four syntypes in the MNHN collection; the lectotype is in the NHMUK (Breure & Ablett, 2014).

Current systematic position: Bulimulidae, *Naesiotus trichodes* (d’Orbigny, 1835).

***Bulimus tropicalis* Morelet, 1849**

Fig. 64

Bulimus tropicalis Morelet, 1849: 9. – Breure, 1979: 124. – Neubert & Janssen, 2004: 233, pl. 16 fig. 194. – Breure & Ablett, 2014: 198, figs 21K, L62ii.

Drymaeus (*Mesembrinus*) *tropicalis*. – Breure & Eskens, 1981: 89. – Thompson, 2011: 121.

Type locality: “ad plagam civitas Campeche”.

Label: “Campeche”, in Moricand’s handwriting.

Dimensions: “Long. 28–Diam. 11 [mm]”; figured specimen herein H 24.3, D 11.0, W 5.9.

Type material: MHNG-INVE-64519, one paralectotype (ex Morelet, Moricand coll.).

Remarks: Morelet did not state on how many specimens his description was based. The lectotype is in the NHMUK (Breure & Ablett, 2014). This sinistral species may prove to be identical with one of the other, dextral, *Drymaeus* species occurring in its distribution

range as enantiomorphy within this group may be more commonly found than currently thought (Breure, unpublished data). The current systematic position follows Thompson (2011).

Current systematic position: Bulimulidae, *Drymaeus* (*Mesembrinus*) *tropicalis* (Morelet, 1849).

***Bulimus tubulatus* Morelet, 1860**

Fig. 99

Bulimus tubulatus Morelet, 1860: 375. – Morelet, 1863: 204, pl. 11 fig. 4.

Bulimulus tubulatus. – Pilsbry, 1896 [1895-1896]: 132, pl. 44 figs 95-96.

Type locality: [Peru] “[intimâ Peruviii regionae]”; see remarks.

Label: “Andahuaylas Pérou”.

Dimensions: “Longit. 19; diam. 6 mill.”; figured specimen herein H 18.5, D 7.14, W 9.0.

Type material: MHNG-INVE-60329, two syntypes (Angrand coll.).

Remarks: Morelet (1860) did not mention on how many specimens his description was based. In his 1863 paper the type locality was specified as “la value d’Andahuaylas”. The current systematic position is according to Richardson (1995).

Current systematic position: Bulimulidae, *Bostryx tubulatus* (Morelet, 1860).

***Helix tupaçii* d’Orbigny, 1835**

Fig. 110

Helix tupaçii d’Orbigny, 1835: 16. – Breure & Ablett, 2014: 199, figs 68D-E, L62iv.

Bulimus tupaçii. – d’Orbigny, 1837 [1834-1847]: 292, pl. 38 figs 1-5 [19 June / 7 Aug 1837; text 6 May 1838]. – Gray, 1854: 18.

Scutalus tupaçii. – Breure, 1975: 1144, pl. 2 fig. 3 (lectotype designation).

Type locality: “provincia Yungasensi (republica Boliviana)”; restricted to Dept. La Paz, Yanacachi (Breure, 1975b).

Label: “Bolivia”, in Moricand’s handwriting.

Dimensions: “Longit. 4 centim.; latit. 2 centim.”; figured specimen herein H 48.4, D 23.6, W 6+.

Type material: MHNG-INVE-60808, three paralectotypes (ex d’Orbigny, Moricand coll.).

Remarks: d’Orbigny (1835) did not state on how many specimens his description was based. In d’Orbigny 1838 [1834-1847]: 292 he corrected the

measurements as “Long. ex 40 ad 75 millim.; lat. ex 12 ad 35 millim.”. In this paper he also specified the localities as “principalement à Yanacache et à Chupé, dans la province de Yungas, et dans celles de Sicasica et d’Ayapaya”; see also Breure (1973: 133, fig. 7). Breure (1975) selected a lectotype from among the syntypes present in the MNHN collection without locality data; further type material is in the NHMUK (Breure & Ablett, 2014). The current systematic position is according to these authors.

Current systematic position: Bulimulidae, *Kuschelenia* (*Kuschelenia*) *tupaçii* (d’Orbigny, 1835).

Helix* (*Cochlogena*) *velutinohispida

S. Moricand, 1836

Fig. 28

Helix (*Cochlogena*) *velutinohispida* S. Moricand, 1836: 429, pl. 2 fig. 4. – Neubert & Janssen, 2004: 234, pl. 17 fig. 203.

Rhinus velutinohispida. – Köhler, 2007: 155, fig. 144.

Type locality: Not given [Brazil, Bahia].

Label: “Bahia”, in Moricand’s handwriting.

Dimensions: “Hauteur, 27 millimètres; largeur, 22 millimètres”; figured specimen herein H 33.0, D 24.0, W 5.3.

Type material: MHNG-INVE-64611, seven syntypes (ex Blanchet, Moricand coll.).

Remarks: Moricand did not mention on how many specimens his description was based. The current systematic position follows Simone (2006).

Current systematic position: Simpulopsidae, *Rhinus velutinohispida* (S. Moricand, 1836).

***Bulimus veruculum* Morelet, 1860**

Fig. 94

Bulimus veruculum Morelet, 1860: 376. – Morelet, 1863: 211, pl. 11 fig. 11. – Breure & Ablett, 2014: 204, figs 3A, L64ii.

Bulimulus (*Geoceras*) *veruculum*. – Pilsbry, 1896 [1895-1896]: 137, pl. 45 fig. 8.

Type locality: [Peru] “[intimâ Peruviii regionae]”; see remarks.

Label: “Pérou, Ayacucho”, in Morelet’s handwriting.

Dimensions: “Long. 24; diam. 4 1/2 millim.”; figured specimen herein H 25.2, D 5.10, W 18.6.

Type material: MHNG-INVE-60384, five syntypes; 60383, four syntypes (Angrand coll.).

Remarks: Morelet (1860) did not state on how many specimens his description was based. In Morelet (1863)

the locality is specified as “Balsa de Cocharcas”, which might be Dept. Ayacucho, Cocharcas. The current systematic position follows Richardson (1995: 50).

Current systematic position: Bulimulidae, *Bostryx veruculum* (Morelet, 1860).

***Bulimus vestalis* Albers, 1854**

Fig. 37

Bulimus vestalis Albers, 1854b: 218.

Naesiotus vestalis. – Köhler, 2007: 139, fig. 80 (lectotype designation).

Type locality: “Columbia [Peru], ad fluvium Maranhon”.

Label: “Columbie”, in Moricand’s handwriting.

Dimensions: “Long. 21, diam. 10 mill.”; figured specimen herein H 16.4, D 8.10, W 6.4.

Type material: MHNG-INVE-60515, two paralectotypes (ex Albers, Moricand coll.).

Remarks: Albers did not state on how many specimens his description was based. The current systematic position accords with that of Köhler (2007), who selected a lectotype from ZMB.

Current systematic position: Bulimulidae, *Naesiotus vestalis* (Albers, 1854).

***Helix (Cochlogena) viminea* S. Moricand, 1834**

Fig. 22

Helix (Cochlogena) viminea S. Moricand, 1834: 540, pl. 1 fig. 5. – S. Moricand, 1836: 432. – Neubert & Janssen, 2004: 234, pl. 17 fig. 215.

Leiostracus (Leiostracus) vimineus. – Köhler, 2007: 154, fig. 141.

Type locality: [Brazil] “le Brésil, dans la province de Bahia”.

Label: “Bahia”, in Moricand’s handwriting.

Dimensions: “Long. 3 centim. Larg. 15 millim.”; figured specimen herein H 28.8, D 13.7, W 6.9.

Type material: MHNG-INVE-64563, nine syntypes (ex Blanchet, Moricand coll.).

Remarks: Moricand did not state on how many specimens his description was based. Other type material is in the SMF (Neubert & Janssen, 2004) and the ZMB (Köhler, 2007). The current systematic position follows Simone (2006).

Current systematic position: Bulimulidae, *Leiostracus vimineus* (S. Moricand, 1834).

***Bulimus virginalis* Morelet, 1860**

Fig. 75

Bulimus virginalis Morelet, 1860: 372.

Type locality: [Peru] “[intimâ Peruvii regione]”; see remarks.

Label: “Tacna”.

Dimensions: “Longit. 28; diam. 14 mill.”. Figured specimen H 27.3, D 15.5, W 5+.

Type material: MHNG-INVE-60272, holotype (Angrand coll.).

Remarks: Morelet (1860) did not mention on how many specimens his description was based. This taxon has been synonymized with *Bostryx hennahi* (J.E. Gray, 1828) by Morelet (1863), who stated “[u]n seul individu de cette espèce a été rencontré sur la côte sablonneuse de Tacna”. The specimen found is thus the holotype. It should be noted that this material is from the same locality as *Helix cactorum* d’Orbigny, 1835; see remarks under that taxon.

Current systematic position: Bulimulidae, *Bostryx hennahi* (J.E. Gray, 1828)?

***Bulimus virgultorum* Morelet, 1863**

Figs 95-96, 102-105

Bulimus virgultorum Morelet, 1863: 194, pl. 10 fig. 1. – Breure, 1979: 59. – Breure & Ablett, 2014: 207, figs 10E, L65ii.

Bulimulus (Lissoacme) virgultorum. – Pilsbry, 1896 [1895-1896]: 168, pl. 10 fig. 1.

Bostryx virgultorum. – Breure, 1978: 139 (lectotype designation).

Type locality: “les vallées chaudes du versant oriental de la Cordillère, notammant celle de Santa-Anna”.

Label: “Ollantaitambo Pérou”, “Cameras del Val de Sta Ana Pérou”, “Sichuan Pérou”, “Ccorihuairachina Pérou”, “Sicuaní Pérou” [60340], “Urubamba Pérou”, “Cchorihuairachina Pérou”, “Puneta del Rey, Valle de Talavera Pérou”, “Pérou” [60341].

Dimensions: “Long. 31; diam. 14 mill.”; figured specimen herein H 30.5, D 15.3, W 7.3.

Type material: MHNG-INVE-60340, nine (1 + 1 + 1 + 5 + 1) paralectotypes; 60341, lectotype and 35 (12 + 2 + 1 + 20) paralectotypes (Angrand coll.).

Remarks: Morelet did not mention on how many specimens his description was based; he figured eight specimens to show the considerable variation within this taxon. Breure (1978) selected a specimen from ‘Urubamba’ and figured by Morelet as lectotype. The classification follows Breure & Ablett (2014).

Current systematic position: Bulimulidae, *Bostryx virgultorum* (Morelet, 1863).

***Bulimus viriatus* Morelet, 1863**

Fig. 127

Bulimus viriatus Morelet, 1863: 170, pl. 7 fig. 4.

Strophocheilus viriatus. – Pilsbry, 1895 [1895-1896]: 54, pl. 27 fig. 99.

Type locality: [Peru] “Niguapata (...) la vallée de Santa-Anna”.

Label: “Niguapata”.

Dimensions: “Longit. 57; diam. 28 mill.”; figured specimen herein H 58.7, D 31.8, W 4.7.

Type material: MHNG-INVE-78772, two syntypes (Angrand coll.).

Remarks: Morelet described this taxon with two specimens at hand; the two specimens were deprived of their epidermis. The original label has been lost. The type locality could not be located with modern gazetteers. The current systematic position is based on similar data from Breure & Romero (2012).

Current systematic position: Orthalicidae, *Kara viriata* (Morelet, 1863) (comb. n.).

***Liguus fasciatus viridis* Clench, 1934**

Fig. 133

Liguus fasciatus viridis Clench, 1934: 105, pl. 6 fig. 11. – Johnson, 2003: 25.

Type locality: “La Caoba, near Dolores, Central Soledad, Cienfuegos, Santa Clara, Cuba”.

Label: “2 miles E of Dolores / Soledad, Cienfuegos / Cuba”.

Dimensions: “Length 48.0 / Width 23.0 (...) mm.”; figured specimen herein H 55.8, D 26.7, W 7+.

Type material: MHNG-INVE-64933, one paratype (ex Fairchild, ex MCZ).

Remarks: Clench presented dimensions of the holotype and five paratypes (in the MCZ collection), but did not mention how many specimens were in the type series. However, besides the type locality, he mentioned eight localities under paratypes, “[a]ll (...) localities in the vicinity of Central Soledad”.

Current systematic position: Orthalicidae, *Liguus fasciatus* (Müller, 1774).

Helix (Cochlogena) rhodospira vulgaris

S. Moricand, 1836

Helix (Cochlogena) rhodospira [var. α] *vulgaris* S. Moricand, 1836: 428.

Type locality: [Brazil] “aux environs de Bahia”.

Label: “Bahia”, in Moricand’s handwriting.

Dimensions: Not given.

Type material: MHNG-INVE-60163, four syntypes (ex Blanchet, Moricand coll.).

Remarks: Moricand did not mention on how many specimens this variety was based. The label reads “var. major”, but it is assumed that this was altered in the final manuscript to ‘vulgaris’. The current systematic position follows Richardson (1995).

Current systematic position: Bulimulidae, *Auris melastoma* (Swainson, 1820).

***Bulimus yanamensis* Morelet, 1863**

Fig. 128

Bulimus yanamensis Morelet, 1863: 171, pl. 8 fig. 3. – Breure, 1979: 40. – Breure & Ablett, 2015: 53, figs 8v-vi, L18ii.

Strophocheilus yanamensis. – Pilsbry, 1895 [1895-1896]: 54, pl. 27 fig. 97.

Thaumastus (Kara) yanamensis. – Breure, 1978: 34 (lectotype designation).

Type locality: [Peru] “Yanama”.

Label: “Yanama Pérou”.

Dimensions: “Longit. 58; diam. 25 (...) mill.”; figured specimen herein H 55.4, D 29.5, W 4.7.

Type material: MHNG-INVE-60202, two syntypes (Angrand coll.).

Remarks: Morelet did not state on how many specimens his description was based. This taxon has been associated with *Kara* Strebel, 1910. On the basis of data published by Breure & Romero (2012), this taxon has been placed in the Orthalicidae.

Current systematic position: Orthalicidae, *Kara yanamensis* (Morelet, 1863).

***Bulimus zigzag* Lamarck, 1822**

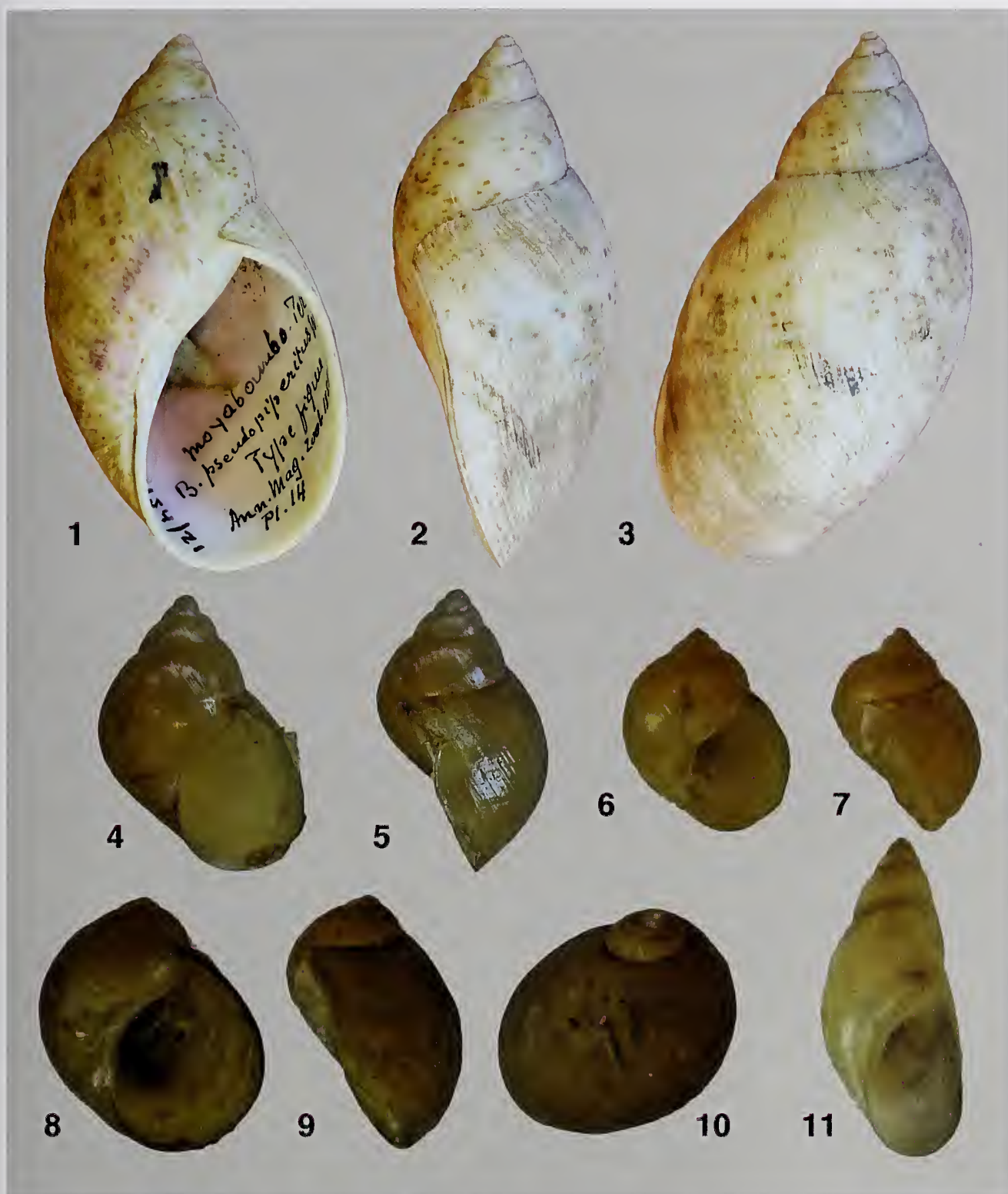
Figs 131-132

Bulimus zigzag Lamarck, 1822: 118. – Lamarck *et al.*, 1838: 223. – Mermod, 1951: 721, fig. 74.

Type locality: “...”.

Label: No locality.

Dimensions: “Longueur, 22 lignes [H = 49 mm]”; figured specimen herein H 50.1, D 31.0, W 5+.



Figs 1-3. Amphibulimidae. (1-3) *Plekocheilus (Eurytus) pseudopiperatus* (J. Moricand, 1858), syntype, MHNG-INVE-55493 (H = 59.1).

Figs 4-11. Simpulopsidae. (4-5) *Simpulopsis (Eudiotus) citrinovitrea* (S. Moricand, 1836), lectotype, MHNG-INVE-64617 (H = 16.0). (6-7) *Simpulopsis (Eudiotus) boissieri* (S. Moricand, 1846), probable syntype, MHNG-INVE-64622 (H = 13.1). (8-10) *Simpulopsis (Simpulopsis) atrovirens* (S. Moricand, 1836), syntype, MHNG-INVE-78487 (H = 20.9). (11) *Simpulopsis (Eudiotus) pseudosuccinea* (S. Moricand, 1836), syntype, MHNG-INVE-64619 (H = 21.8).

Type material: MHNG-INVE-51144, two syntypes (Lamarck coll.).

Remarks: Lamarck did not mention on how many specimens his description was based; one of the shells found is subadult. Deshayes & Milne Edwards (in Lamarck *et al.*, 1838) considered this taxon “qu’une jolie variété de la suivante, le *Bulimus undatus*”. Pilsbry (1899: 136) doubtfully referred this taxon to *Achatina pulchella* Spix, 1827 (= *Orthalicus pulchellus*). Mermod (1951) suggested that one of the two specimens he found was likely not originating from the Lamarck collection, as it has a “S” inscribed on it, denoting it came from the collection of L. du Sollier, Comte de la Touche. Upon checking, none of the shells in the current lot is marked with “S”. On the label of Lamarck it appears, moreover, that two shells were once glued; therefore both specimens are considered as syntypes. The smallest specimen is figured herein as it best matches the dimensions given in the original publication. When comparing the specimens to other known taxa, Mermod noticed that they were very similar to those of *Orthalicus obductus* Shuttleworth, 1856 (see Neubert & Gosteli 2003: 40, pl. 6 fig. 3, who illustrated one of the syntypes). Compared to their figure, the shape of the aperture is somewhat different and the last whorl of Shuttleworth’s shell seems slightly more globose, but this needs further study of the variation within these two taxa.

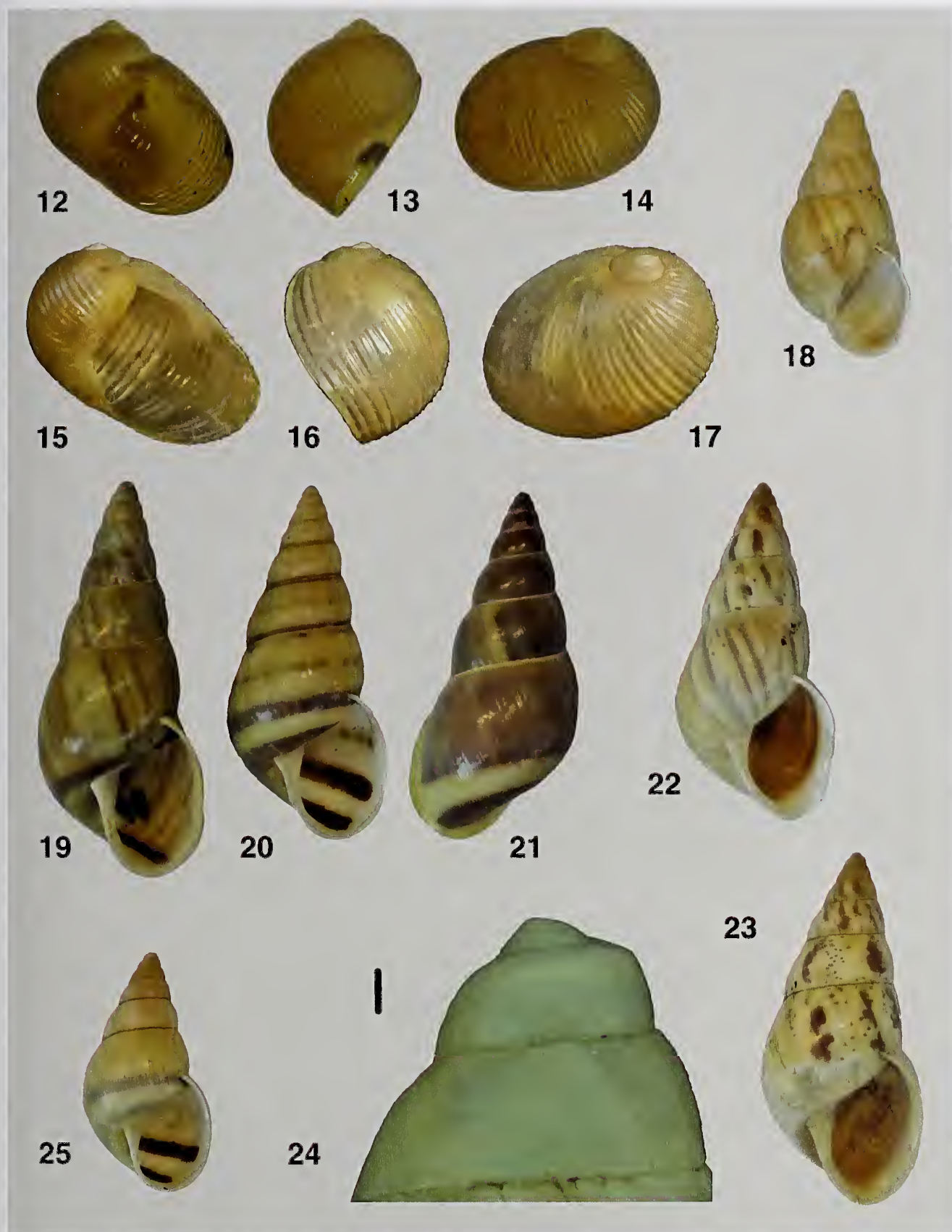
Current systematic position: Orthalicidae, *Orthalicus zigzag* (Lamarck, 1819).

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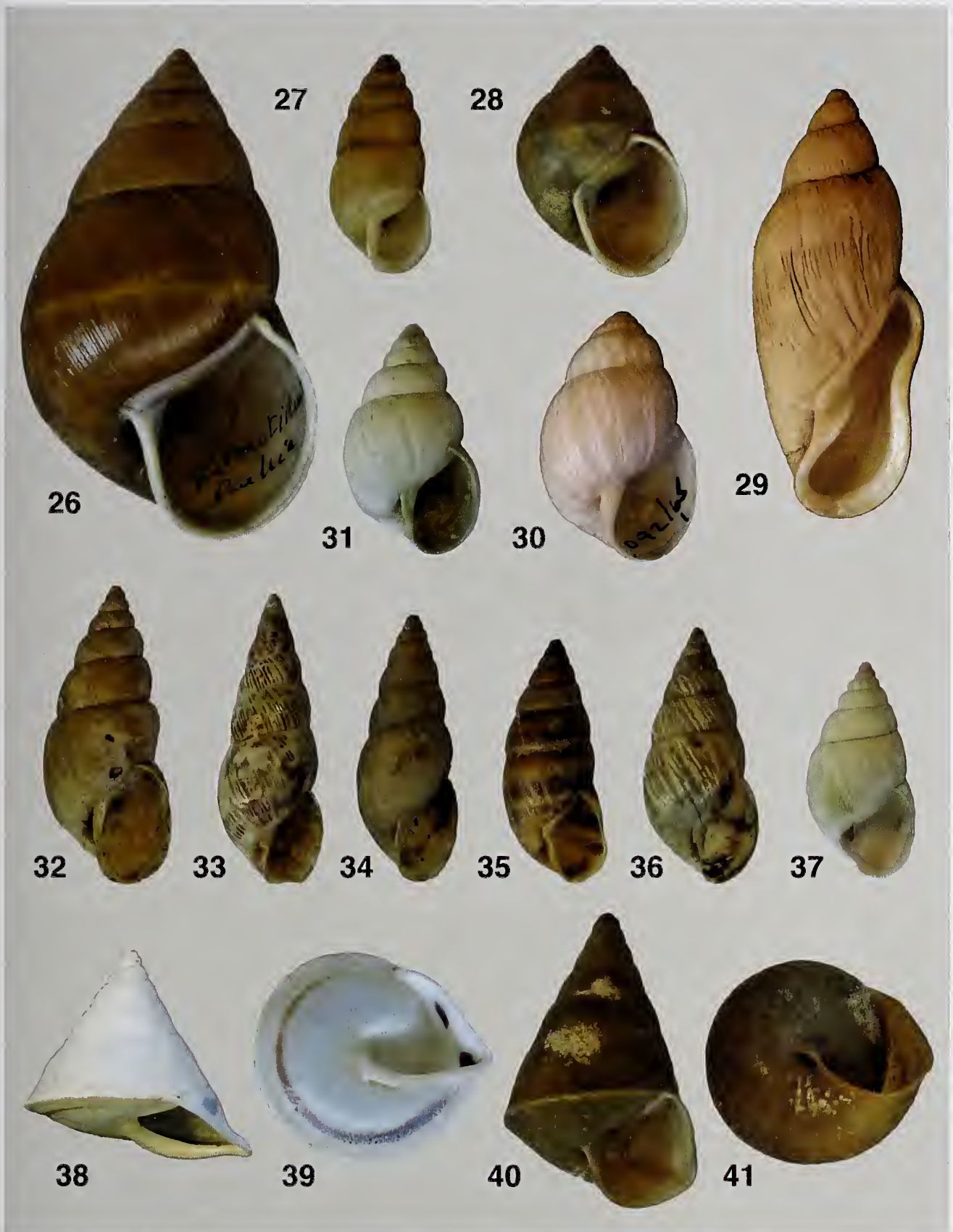
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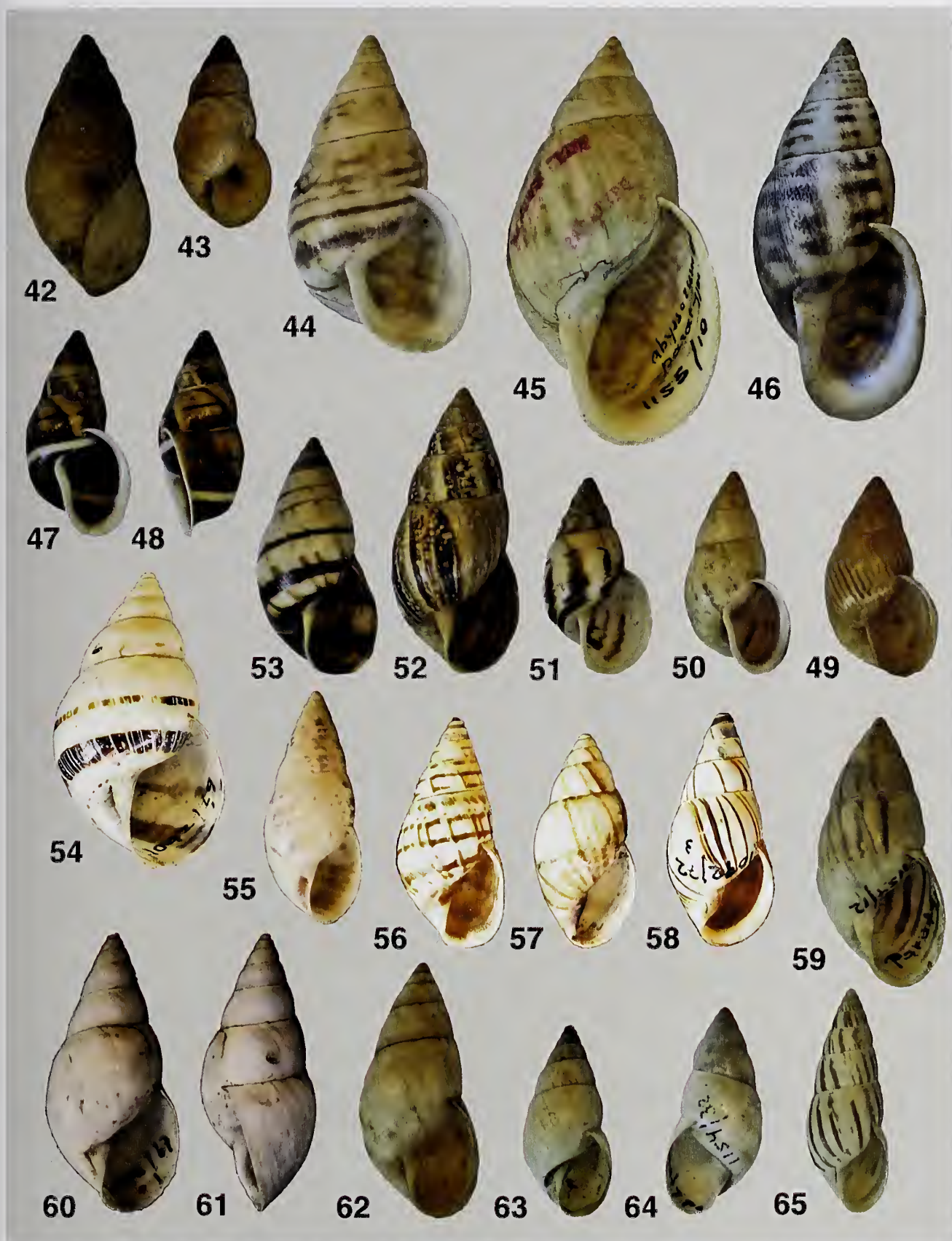
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- Figs 26-28. Simpulopsidae. (26) *Rhinus heterotricha* (S. Moricand, 1836), syntype, MHNG-INVE-64602 (H = 53.4). (27) *Rhinus pubescens* (S. Moricand, 1846), syntype, MHNG-INVE-64606 (H = 15.6). (28) *Rhinus velutinohipida* (S. Moricand, 1836), syntype, MHNG-INVE-64611 (H = 33.0).
- Figs 29-30. Bothriembryontidae. (29) *Euplacostylus koroensis* (Garrett, 1872), probable paralectotype, MHNG-INVE-64767 (H = 47.7). (30) *Bothriembryon costulatus* (Lamarck, 1822), syntype, MHNG-INVE-51162 (H = 26.0).
- Figs 31-41. Bulimulidae. (31) *Rabdotus dealbatus* (Say, 1821), paratype of *Bulimulus dealbatus jonesi* Clench, 1937, MHNG-INVE-60529 (H = 18.1). (32) *Naesiotus crepundia* (d'Orbigny, 1835), paralectotype, MHNG-INVE-60497 (H = 22.8). (33) *Naesiotus dentritus* (Morelet, 1863), lectotype, MHNG-INVE-60432 (H = 20.8). (34) *Naesiotus montivagus* (d'Orbigny, 1835), paralectotype, MHNG-INVE-60505 (H = 19.4). (35) *Naesiotus snodgrassi* (Dall, 1900), paratype, MHNG-INVE-60518 (H = 17.3). (36) *Naesiotus trichodes* (d'Orbigny, 1835), paralectotype, MHNG-INVE-60513 (H = 18.5). (37) *Naesiotus vestalis* (Albers, 1854), paralectotype, MHNG-INVE-60515 (H = 16.4). (38-39) *Oxychona pyramidella* (Wagner in Spix, 1827), syntype of *Helix (Helicigona) blanchetiana* S. Moricand, 1834, MHNG-INVE-60674 (H = 15.6). (40-41) *Pseudoxychona pileiformis* (S. Moricand, 1836), syntype, MHNG-INVE-64567 (H = 19.5). ▶



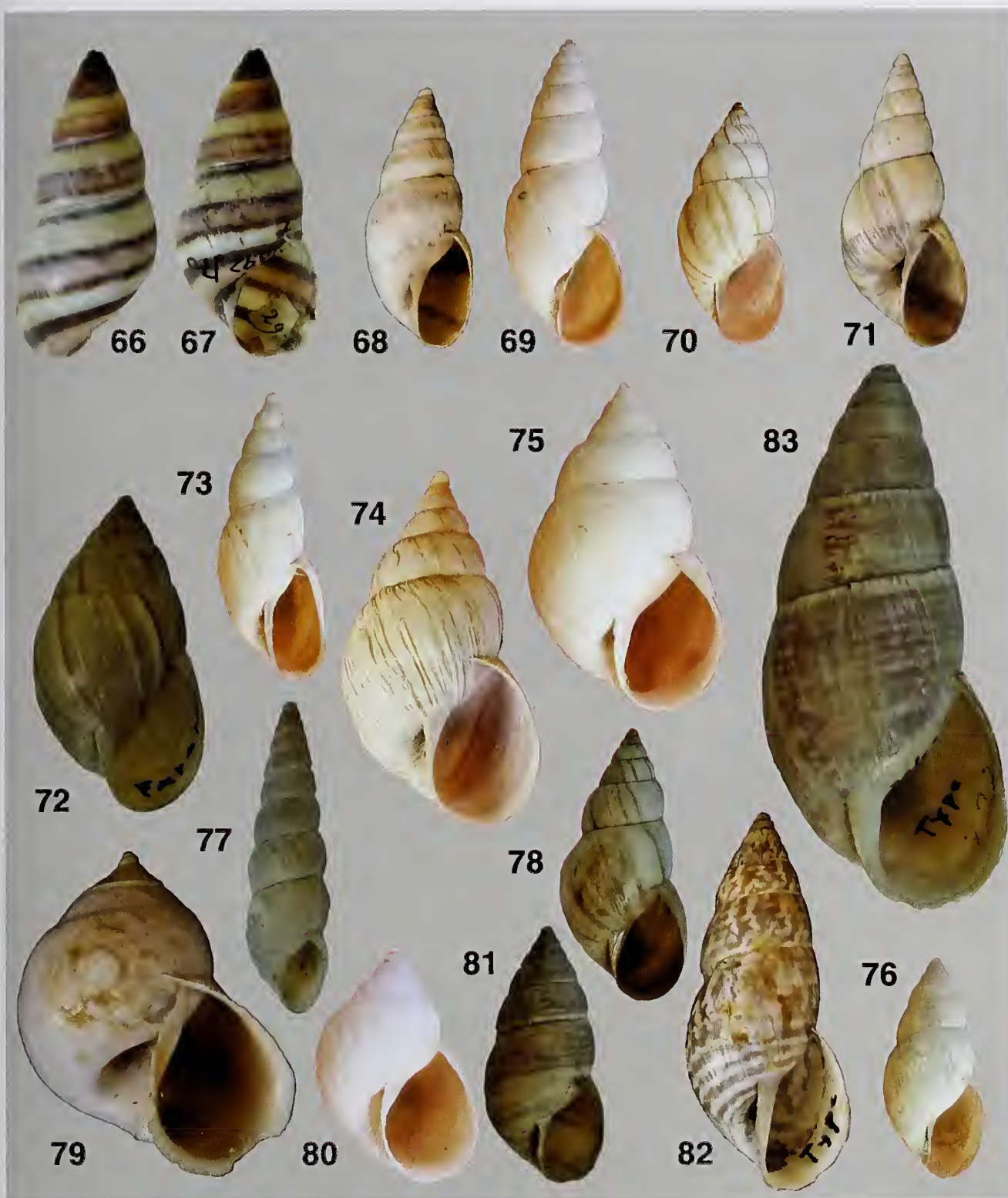
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Figs 42-65. Bulimulidae. (42) *Bulimulus heloicus* (d'Orbigny, 1835), syntype, MHNG-INVE-79903 (H = 22.4). (43) *Bulimulus unicolor* (Sowerby 1, 1833), paralectotype of *Bulimus petenensis* Morelet, 1851, MHNG-INVE-60291 (H = 16.2). (44) *Cochlorina aurismuris* (Moricand, 1838), syntype, MHNG-INVE-60683 (H = 31.5). (45-46) *Drymaeus* (*Drymaeus*) *abyssorum* (d'Orbigny, 1835), respectively paralectotype of *Helix abyssorum* d'Orbigny, 1835, MHNG-INVE-63420 (H = 46.9), and paralectotype of *Helix hygrohyla* d'Orbigny, 1835, MHNG-INVE-63469 (H = 43.9). (47-50) *Drymaeus* (*Drymaeus*) *strigatus* (Sowerby 1, 1833), (47-48) syntype of *Bulimus mariae* J. Moricand, 1858, MHNG-INVE-64389 (H = 23.3), (49) syntype of *Bulimus ceciliae* J. Moricand, 1858, MHNG-INVE-63436 (H = 22.3), (50) syntype of *Bulimus delphinae* J. Moricand, 1858, MHNG-INVE-63443 (H = 22.4). (51) *Drymaeus* (*Drymaeus*) *similaris* (J. Moricand, 1856), syntype, MHNG-INVE-63531 (H = 23.6). (52) *Drymaeus* (*Drymaeus*) *sachsei* (Albers, 1854), syntype, MHNG-INVE-63524 (H = 31.9). (53) *Drymaeus* (*Drymaeus*) *poecilus* (d'Orbigny, 1835), paralectotype, MHNG-INVE-63506 (H = 26.8). (54) *Drymaeus* (*Drymaeus*) *mexicanus* (Lamarck, 1822), syntype, MHNG-INVE-51166 (H = 30.9). (55) *Drymaeus* (*Drymaeus*) *draparnaudi* (Pfeiffer, 1847), paralectotype of *Helix torallyi* d'Orbigny, 1835 [partim], MHNG-INVE-60326 (H = 24.9). (56-58) *Drymaeus* (*Mesembrinus*) *virgulatus* (Férussac, 1821), syntypes of *Bulimus caribaeorum* Lamarck, 1822, MHNG-INVE-51169 (H = 26.0). (59) *Drymaeus* (*Mesembrinus*) *oreades* (d'Orbigny, 1835), paralectotype, MHNG-INVE-64483 (H = 31.4). (60-61) *Drymaeus* (*Mesembrinus*) *fragilis* (Lamarck, 1822), syntype (H = 28.3). (62) *Drymaeus* (*Mesembrinus*) *immaculatus* (C.B. Adams in Reeve, 1850), paralectotype, MHNG-INVE-64442 (H = 29.7). (63) *Drymaeus* (*Mesembrinus*) *multilineatus* (Say, 1825), paralectotype of *Bulimus sisalensis* Morelet, 1849, MHNG-INVE-64471 (H = 21.4). (64) *Drymaeus* (*Mesembrinus*) *tropicalis* (Morelet, 1849), paralectotype, MHNG-INVE-64519 (H = 24.3). (65) *Drymaeus* (*Mesembrinus*) *leucomelas* (Albers, 1854), paralectotype, MHNG-INVE-64455 (H = 25.9).

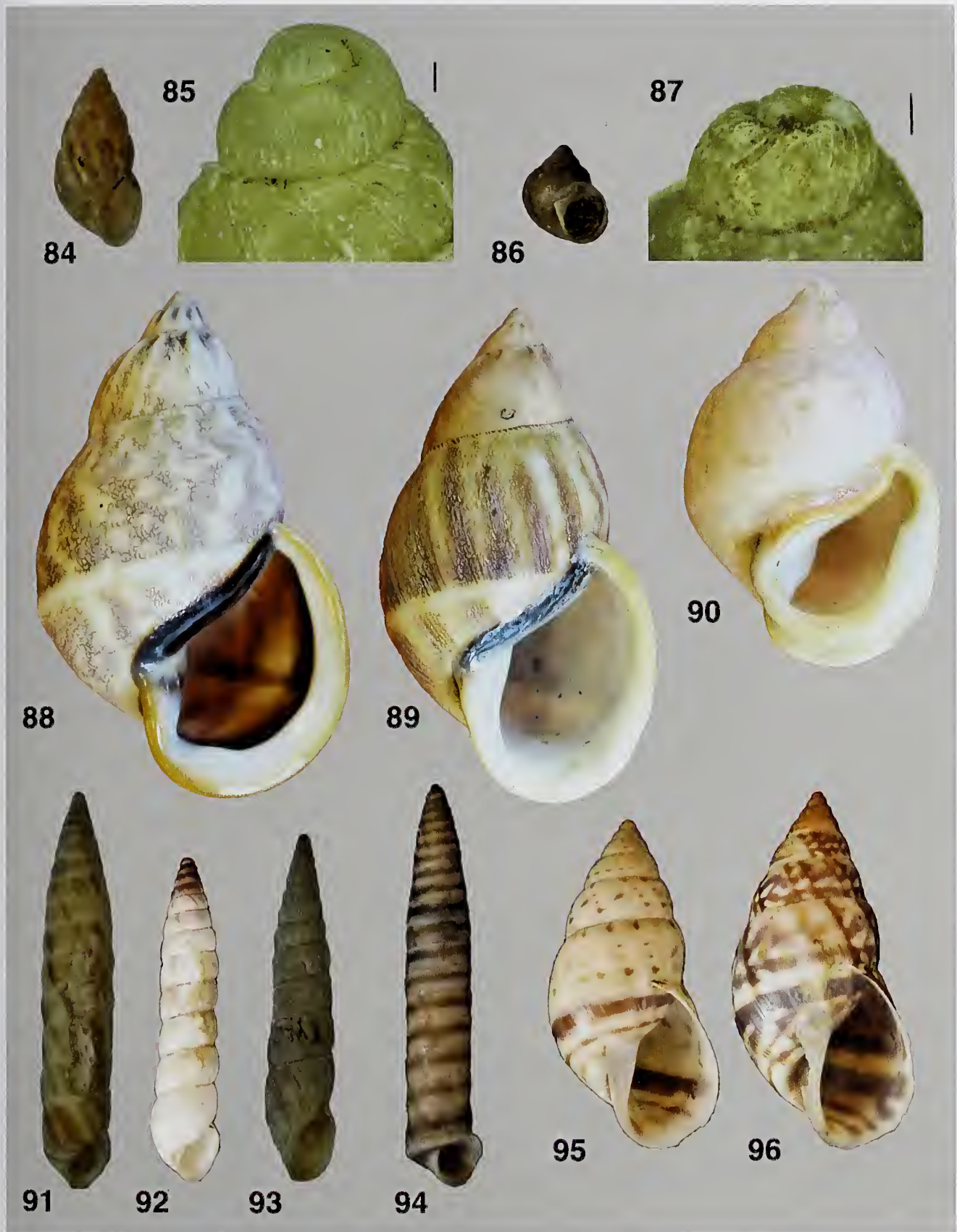


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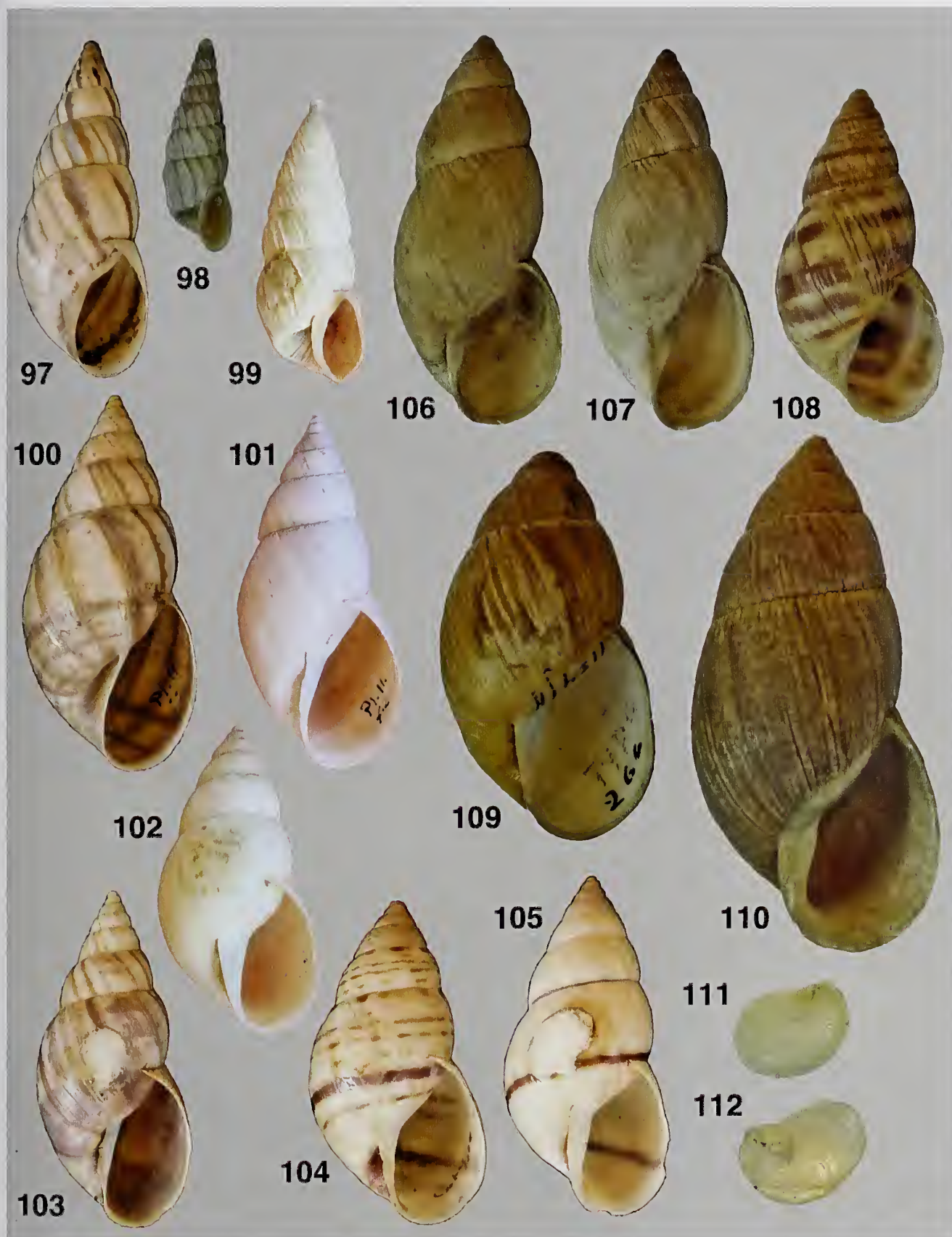
Figs 66-83. Bulimulidae. (66-67) *Drymaeus (Mesembrinus) multifasciatus* (Lamarck, 1822), syntype, MHNG-INVE-51167 (H = 25.7). (68-71) *Bostryx albicolor* (Morelet, 1860), (68) syntype of *Bulimus lesueureanus* Morelet, 1860, MHNG-INVE-60380 (H = 21.1), (69) syntype of *Bulimus albicolor* Morelet, 1863, MHNG-INVE-60231 (H = 25.4), (70) probable syntype of *Bulimus cercicola* Morelet, 1863, MHNG-INVE-60260 (H = 19.6), (71) paralectotype of *Bulimus orophilus* Morelet, 1863, MHNG-INVE-60289 (H = 23.3). (72) *Bostryx apodemetus* (d'Orbigny, 1835), syntype, MHNG-INVE-60419 (H = 25.5). (73) *Bostryx andoicus* (Morelet, 1863), paralectotype, MHNG-INVE-60235 (H = 23.5). (74-75) *Bostryx hennahi* (J.E. Gray, 1830), (74) paralectotype of *Helix cactorum* d'Orbigny, 1835, MHNG-INVE-20659 (H = 28.8), (75) holotype of *Bulimus virginalis* Morelet, 1860, MHNG-INVE-60272 (H = 27.3). (76) *Bostryx nigropileatus* (Reeve, 1849), possible paralectotype of *Bulimus balsanus* Morelet, 1863, MHNG-INVE-60244 (H = 17.9), (77) *Bostryx emaciatus* (Morelet, 1863), lectotype, MHNG-INVE-60408 (H = 21.0). (78) *Bostryx angrandianus* (Pilsbry, 1897), paralectotype of *Bulimus radiatus* Morelet, 1863, MHNG-INVE-60295 (H = 23.9). (79) *Bostryx papillatus* (Morelet, 1860), syntype, MHNG-INVE-60388 (H = 24.8). (80) *Bostryx rusticellus* (Morelet, 1860), paralectotype, MHNG-INVE-60304 (H = 20.1). (81) *Bostryx piuranus* (Albers, 1854), paralectotype, MHNG-INVE-60294 (H = 23.7). (82) *Bostryx serotinus* (Morelet, 1860), paralectotype, MHNG-INVE-60313 (H = 29.8). (83) *Kuschelenia (Bocourtia) angrandi* (Morelet, 1860), holotype, MHNG-INVE-60610 (H = 49.9). ▶

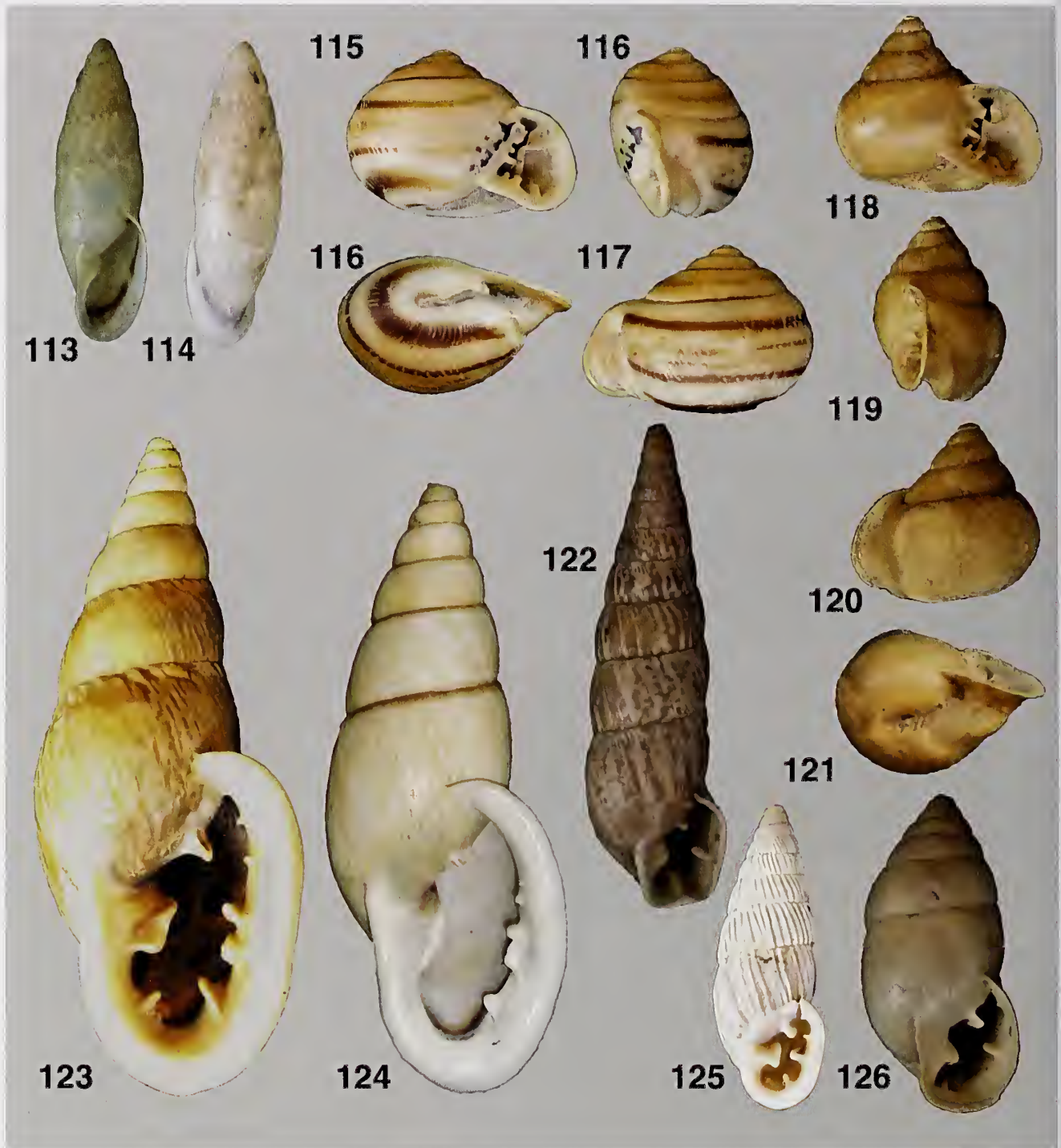


Figs 84-96. Bulimulidae. (84-85) *Protoglyptus heterogrammus* (S. Moricand, 1836), syntype, MHNG-INVE-64598 (H = 12.5), scale 0.5 mm. (86-87) *Protoglyptus longisetus* (S. Moricand, 1846), syntype, MHNG-INVE-64605 (H = 6.91), scale 0.5 mm. (88) *Auris melastoma* (Swainson, 1820), syntype of *Helix (Cochlogena) rhodospira chrysostoma* S. Moricand, 1836, MHNG-INVE-60161 (H = 56.4). (89) *Auris illheocolus* (S. Moricand, 1836), syntype, MHNG-INVE-60171 (H = 66.7). (90) *Auris egregia* (Jay, 1836), syntype of *Helix (Cochlogena) maximiliana minor* S. Moricand, 1836, MHNG-INVE-60152 (H = 38.2). (91) *Bostryx cuspidatus* (Morelet, 1863), syntype, MHNG-INVE-60377 (H = 30.2). (92) *Bostryx acromelas* (Morelet, 1863), syntype, MHNG-INVE-60378 (H = 19.8). (93) *Bostryx spiculatus spiculatus* (Morelet, 1860), paralectotype, MHNG-INVE-60411 (H = 23.3). (94) *Bostryx veruculum* (Morelet, 1860), syntype, MHNG-INVE-60384 (H = 25.2). (95-96) *Bostryx virgultorum* (Morelet, 1863), paralectotype respectively lectotype, MHNG-INVE-60341 (H = 30.5). ►

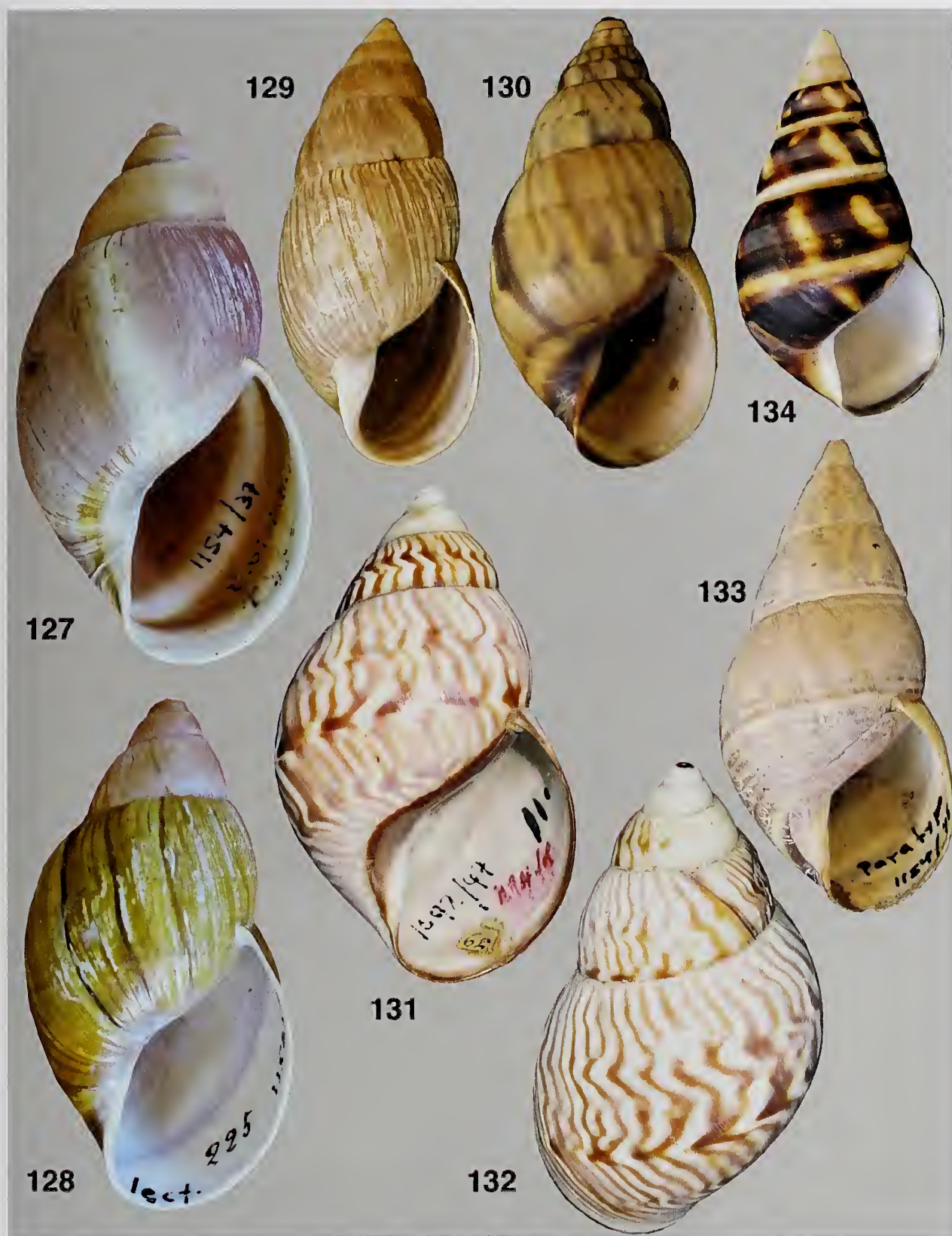


Figs 97-112. Bulimulidae. (97) *Bostryx torallyi* (d'Orbigny, 1835). Paralectotype, MHNG-INVE-60326 (H = 27.9). (98) *Bostryx tubulatus scalaricostus* (Morelet, 1860), paralectotype, MHNG-INVE-60407 (H = 15.5). (99) *Bostryx tubulatus tubulatus* (Morelet, 1860), syntype, MHNG-INVE-60329 (H = 18.5). (100-101) *Bostryx longinquus* (Morelet, 1863), lectotype respectively paralectotype, MHNG-INVE-60283 (H = 29.9). (102-105) *Bostryx virgultorum* (Morelet, 1863), paralectotype, MHNG-INVE-60341 (H = 30.4). (106) *Kuschelenia (Kuschelenia) culminea culminea* (d'Orbigny, 1835), paralectotype, MHNG-INVE-60575 (H = 33.2). (107-108) *Kuschelenia (Kuschelenia) culminea edwardsi* (Morelet, 1863), syntype, MHNG-INVE-60581 (H = 33.0). (109) *Kuschelenia (Bocourtia) ochracea* (Morelet, 1863), lectotype, MHNG-INVE-60615 (H = 38.5). (110) *Kuschelenia (Kuschelenia) tupacii* (d'Orbigny, 1835), paralectotype, MHNG-INVE-60808 (H = 48.4). Figs 111-112. Amphibulimidae. (111-112) *Gaeotis nigrolineata* Shuttleworth, 1854, possible syntype, MHNG-INVE-64746 (D = 9.0). ►

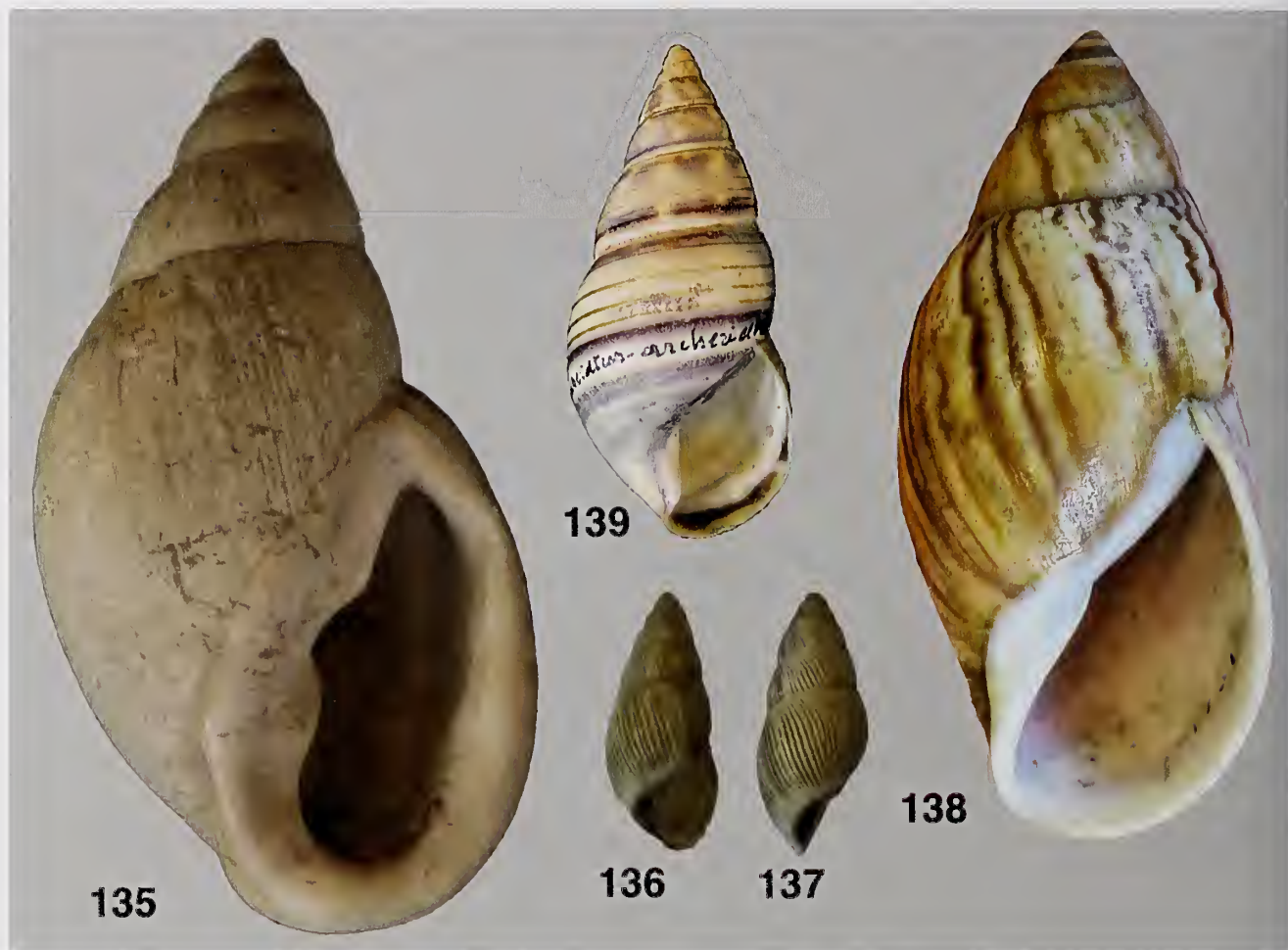




Figs 113-126. Odontostomidae. (113-114) *Bahiensis bahiensis* (S. Moricand, 1834), syntype, MHNG-INVE-64638 (H = 18.5). (115-117) *Tomigerus clausus* (Spix, 1827), syntype of *Helix (Cochlodonta) tomigera* S. Moricand, 1836, MHNG-INVE-64717 (H = 10.1). (118-121) *Biotocus turbinatus* (Pfeiffer, 1845), syntype of *Helix tomigeroides* S. Moricand, 1846, MHNG-INVE-64718 (H = 11.4). (122) *Spixia striata* (Spix, 1827), paralectotype of *Pupa spixii major* d'Orbigny, 1837, MHNG-INVE-64662 (H = 34.6). (123-124) *Burringtonia pantagruelina* (S. Moricand, 1834), (123) syntype, MHNG-INVE-64695 (H = 52.9), (124) syntype of *Helix (Cochlodina) pantagruelina minor* S. Moricand, 1836, MHNG-INVE-64698 (H = 45.1). (125) *Cyclodontina inflata* (Wagner in Spix, 1827), specimen from original series of *Bulimus scabrellus* 'Anthony' Dohrn, 1882, MHNG-INVE-64686 (H = 19.7). (126) *Plagiodontes patagonicus* (d'Orbigny, 1835), paralectotype, MHNG-INVE-64708 (H = 22.2).



Figs 127-134. Orthalicidae. (127) *Kara viriata* (Morelet, 1863), syntype, MHNG-INVE-78772 (H = 58.7). (128) *Kara yanamensis* (Morelet, 1863), syntype, MHNG-INVE-60202 (H = 55.4). (129) *Scholvienia jaspidea* (Morelet, 1863), syntype, MHNG-INVE-60211 (H = 47.2). (130) *Orthalicus phlogerus* (d'Orbigny, 1835), syntype, MHNG-INVE-64982 (H = 47.2). (131-132) *Orthalicus zigzag* (Lamarck, 1822), syntype, MHNG-INVE-51144 (H = 50.1). (133-134) *Liguus fasciatus* (Müller, 1774), (133) paratype of *Liguus fasciatus viridis* Clench, 1934, MHNG-INVE-64933 (H = 55.8), (134) paratype of *Liguus crenatus barbouri* Clench, 1929, MHNG-INVE-64938 (H = 43.2).



- Fig. 135. Bothriembryontidae. *Placostylus porphyrostomus monackensis* (Crosse, 1888), possible syntype of *Bulimus duplex major* Gassies, 1871, MHNG-INVE-64837 (H = 88.0).
- Figs 136-137. Bulimulidae. (136-137) *Drymaeus (Mesembrinus) polygrammus* (S. Moricand, 1836), syntype, MHNG-INVE-64561 (H = 14.0).
- Fig. 138. Amphibulimidae. *Dryptus pardalis* (Férussac, 1821), syntype, MHNG-INVE-60142 (H = 70.2).
- Fig. 139. Orthalicidae. *Liguus fasciatus* (Müller, 1774), paratype of *Liguus fasciatus archeri* Clench, 1934, MHNG-INVE-64921 (H = 54.5).



Figs 140-143. Amphibulimidae. *Amphibulima patula* (Bruguière, 1789), holotype of *A. cucullata* Lamarck, 1805, MHNG-INVE-51201 (H = 31.0).

An extraordinary new species of *Psyllipsocus* (Psocodea: ‘Psocoptera’: Psyllipsocidae) from the Biosphere Reserve Sierra de Huautla, Morelos, Mexico

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Abstract: The insect species *Psyllipsocus stupendus* spec. nov., living on rock outcrops, is described and illustrated from central Mexico (Morelos state). Although the general morphology is typical for a *Psyllipsocus* species, both male and female are characterized by very peculiar genitalia. In the male, the phallosome has a pair of long pointed claspers and, surprisingly, the basal struts are not anteriorly but posteriorly directed. In the female, the first and second ovipositor valvulae, usually much reduced in this genus, are well developed and strongly sclerotized, forming a tube-like structure together with the sclerotized wall of the proximal part of the vagina. The dorsal wall of the female genital chamber is transversally double-folded, resulting in a ventral main compartment and an eversible dorsal compartment. The opening of the spermathecal duct (spermapore) opens proximally into the dorsal compartment. A similar structure of the female genital chamber has never been observed in Psocoptera before. Some functional hypotheses are discussed and it is postulated that a special form of selective pressure, probably due to sexual selection, might have favoured the evolution of these unique genital structures.

Keywords: Insecta - female genital chamber - sclerotized vagina - phallic claspers.

INTRODUCTION

The New World Psyllipsocidae (‘Psocoptera’: Trogiomorpha) are relatively well studied and comprehensive keys to genera and species are available (Mockford, 1993, 2011; Lienhard & Ferreira, 2015). At present, the genus *Psyllipsocus* Selys-Longchamps, 1872, includes 40 New World species, 24 of them known from North and Middle America (Mockford, 2011) and 18 from South America (Lienhard & Ferreira, 2015).

Many species of this genus live on bark of trees, in soil litter or on lichen-covered rock outcrops (Mockford, 2011), while many others are known only from caves (Lienhard & Ferreira, 2015); one of them, *Psyllipsocus ramburii* Selys-Longchamps, 1872, is a cosmopolitan domestic species (Lienhard & Smithers, 2002). Here we describe a new Mexican species living on rock outcrops in the mountains of the Sierra de Huautla (Morelos state). Its general morphology is typical for the genus *Psyllipsocus* but it is characterized by very peculiar male and female genitalia.

MATERIAL AND METHODS

The material examined is deposited in the following institutions: Muséum d’histoire naturelle, Geneva, Switzerland (MHNG); National Insect Collection at Instituto de Biología, Universidad Nacional Autónoma de México (CNIN).

Dissection and slide-mounting followed the methods described by Lienhard (1998). The pilosity of wing veins is heavily damaged in the material studied. For Fig. 1A it was reconstructed on the basis of the insertion points of the hairs, which are readily visible in slide-mounted wings, and of the few hairs which were not lost. The length of these hairs was considered as representative for the pilosity of the entire wing, based on the observation that in *Psyllipsocus* the length of wing ciliation is normally uniform over the whole wing. In the description, the terms microspades organ (pedicel), coxal organ (hindleg), setal organ (paraproct), phallic cradle and endophallic tube (male genitalia) are used *sensu* Mockford (1993, 2011). Abbreviations used in the description: AP = areola postica (a marginal cell in forewing formed by veins CuA1 and CuA2); bcc = length of basal closed cell in forewing; BL

= body length (in alcohol); dcc = length of distal closed cell in forewing; F = hindfemur (length); FW = forewing (length); FWw = forewing (greatest width); HW = hindwing (length); IO/D = shortest distance between compound eyes divided by longitudinal diameter of compound eye in dorsal view of head; P2 = second article of maxillary palp; P4 = fourth (terminal) article of maxillary palp; T = hindtibia (length); t1, t2, t3 = tarsomeres of hindtarsus (length, measured from condyle to condyle); v1, v2, v3 = first (ventral), second (dorsal) and third (external) ovipositor valvula respectively. Abbreviations of wing veins are used according to Yoshizawa (2005). For other abbreviations see legends to the figures.

TAXONOMIC PART

Psyllipsocus stupendus sp. nov.

Figs 1-4

Holotype: MHNG; male (slide-mounted); Mexico, Morelos state, Biosphere Reserve Sierra de Huautla, 2.5 km N and 4 km W of the Centro de Educación Ambiental e Investigación Sierra de Huautla (CEAMISH), 940 m; 12.-17.iii.1996, Malaise trap 2; 18° 27'.671 N, 99° 02'.475 W [right wings and left maxillary palp lacking].

Paratypes: MHNG and CNIN (slide-mounted or in alcohol). – 6 males, 6 females (one of them allotype); same locality as for holotype; ii.-vi.1996, Malaise traps. – 1 female, 1 nymph; same locality, on rock outcrop; 9.vi.1996, leg. T. Martínez. – 1 female; Mexico, Morelos state, Biosphere Reserve Sierra de Huautla, Municipio de Tepalcingo, El Limón de Cuauichichinola, 1200 m, on rock outcrop; 11.v.1996, leg T. Martínez.

Diagnosis: This new species can be distinguished from all known species of the genus *Psyllipsocus* by the very particular male and female genitalia, the general structure of which is already observable in non-dissected specimens in alcohol.

Etymology: The species epithet (Latin: stupendus, -a, -um) refers to the astonishing male and female genitalic structures.

Description: General colouration yellowish to medium brown. Head without particular facial markings, compound eye brown, maxillary palp uniformly light to medium brown, antenna light brown. Legs: femur light brown, tibia medium brown with whitish sub-basal zone, tarsus medium brown. Forewing hyaline with more or less intense brown markings along several veins in apical half (Fig. 1A), hindwing hyaline (Fig. 1B). Abdomen whitish, basally and laterally with some brown hypodermal pigment, terminalia brown.

Both sexes macropterous (Fig. 1AB). Forewing: Rs and M fused for a length; distal closed cell slightly shorter

than marginal length of pterostigma and much shorter than basal closed cell (bcc/dcc \approx 3.6); first portion of pterostigmal R1 about equal in length to R1-Rs crossvein; CuA1 strongly curved, AP relatively short and high. Hindwing: Basal portion of Rs not differentiated and R1 originating from Rs-M fusion, thus closed cell triangular. Three ocelli present. Pilosity of frons and vertex almost uniform. Antenna with at least 23 segments (most antennae damaged); antennal flagellomeres with uneven surface (due to insertion points of long and relatively thick setae), in basal half of antenna maximal length of flagellar hairs about 5x greatest width of their flagellomeres; pedicellar microspades organ weakly developed (with only one unit). P2 with a weakly differentiated stout sensillum in basal half (somewhat thicker than other setae of similar length); P4 slender hatchet-shaped, with a prominent subapical sensillum (Fig. 1F). Lacinial tip as in Fig. 1E. Pretarsal claws simple, symmetrical, with a small preapical denticle; hind legs with well-developed coxal organ. Epiproct and paraproct simple in both sexes (Fig. 1G), anal spine long, setal organ consisting of two fine setae of about equal length, but the ventral seta somewhat thicker than the dorsal one, paraproctal sensorium with 6-7 fine trichobothria on basal florets and one normal seta.

Male genitalia: Hypandrium and phallosome forming a ventrally bulged structure of about half the length of the abdomen, laterally articulated to the sclerotized rod-like antero-lateral margin of the clunium (Fig. 1C). Hypandrium with a distinct posterior lobe (Fig. 1D); some long hairs on the lobe and near its base, remaining pilosity shorter (pilosity not shown in the figures); near base of the posterior lobe a pair of small dorsal hooked sclerites (Figs 1D, 2B), probably linked by ligaments to the phallic cradle and/or to the endophallic tube. Phallic cradle differentiated as a well-sclerotized frame on inner wall of hypandrium (Fig. 2A). Phallosome complex (Figs 1D, 2C), with a pair of slender, movable, slightly curved and acutely pointed claspers; endophallic tube basally on each side with a half-moon shaped plate and distally tapering towards a pair of narrowly rounded and slightly curved tips; a pair of posteriorly directed basal struts inserted medially near anterior margin of hypandrium (forming a posteriorly opened V in ventral view; see Fig. 1CD, interrupted lines), each strut linked to phallic cradle by a less sclerotized foliaceous structure (Fig. 2C, dotted lines) attached on a small lateral denticle situated in about one third of its length.

Female genitalia: Complex sclerotized structures of v1, v2, vagina and spermapore plate readily visible through the largely membranous subgenital plate in ventral view (Fig. 1G). Subgenital plate membranous dorsally, at most weakly sclerotized ventrally, roughly triangular, bearing hairs of medium length on ventral surface but no particularly long setae on hind margin. Gonapophysis v3 typical for the genus (Fig. 3A), almost rectangular, weakly sclerotized, bearing some stouter laterodistal

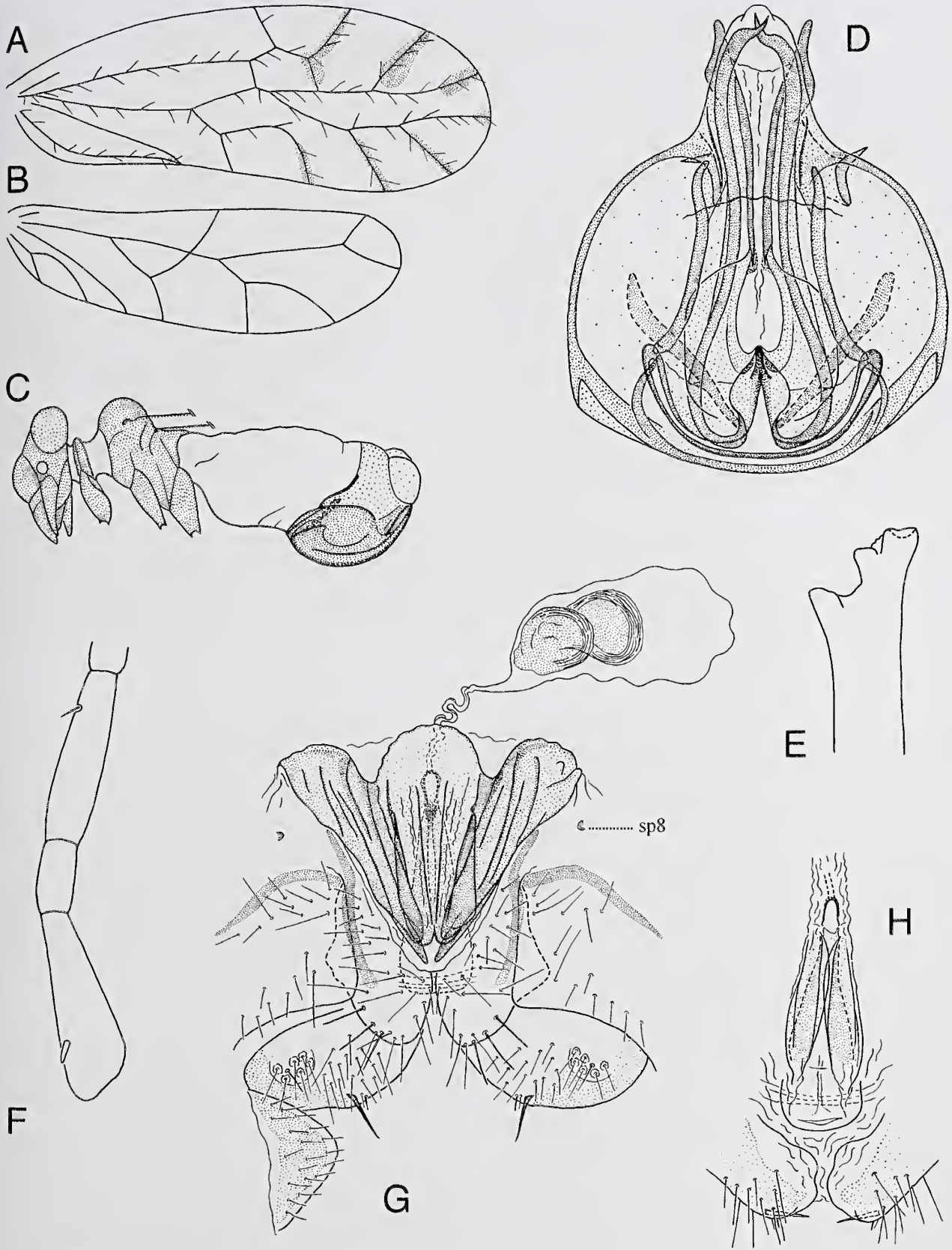


Fig. 1. *Psyllipsocus stupendus* sp. nov. (A) Forewing, female. (B) Hindwing, female. (C) Male habitus, lateral view (antennae, palps, legs and wings not shown). (D) Male holotype, hypandrium and phallosome, ventral view (pilosity not figured; basal struts shown by interrupted lines). (E) Lacinial tip, male. (F) Maxillary palp, male (ordinary pilosity not shown). (G) Female allotype (no. 8162), ventral view of dissected abdominal apex, see also Fig. 4B (pilosity of subgenital plate not shown; sp8 = spiracle of 8th segment). (H) Female paratype (no. 8163), spermapore plate and distal parts of paraprocts, ventral view, see also Fig. 4C.

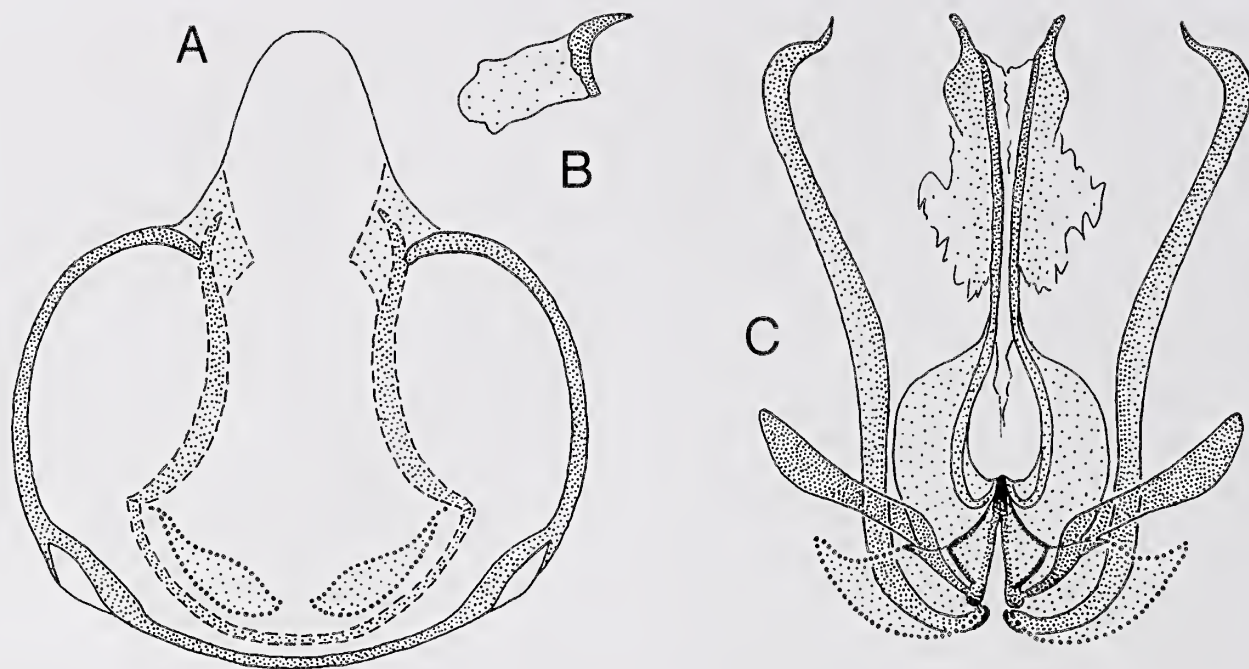


Fig. 2. *Psyllipsocus stupendus* sp. nov., schematic representation of male genitalia. (A) Hypandrium with phallic cradle (interrupted lines) and basal connecting sclerites (dotted lines) between phallic cradle and phallic sclerites (medially detached from phallic sclerites), ventral view. (B) Detached right hooked sclerite with part of ligament (in situ situated dorsally near base of posterior hypandrial lobe, see Fig. 1D). (C) Phallic claspers, endophallic tube, basal struts and basal connecting sclerites (dotted lines, laterally detached from phallic cradle), dorsal view; endophallic tube damaged laterally in posterior half by pulling out of phallic cradle during dissection.

setae (somewhat thicker than other setae of same length); v1 and v2 well-developed, elongated and strongly sclerotized (Fig. 3AB), basally widened and connected to the sclerotized and longitudinally folded dorsal wall of the vagina (Fig. 3B). Posterior part of this sclerotized vaginal tube laterally articulated to its anterior part by a joint-like connection (x in Fig. 3B). Dorsal wall of the genital chamber transversally double-folded, resulting in a ventral main compartment, dorsally delimited by the sclerotized vaginal wall, and a dorsal secondary compartment, dorsally delimited by the spermapore plate (Fig. 4B). Spermapore plate elongated and well-sclerotized, with a longitudinal ventral bulge on each side covering a region of glandular tissue (Fig. 3B, interrupted lines); spermapore opened into an ovally semicircular sclerite at the anterior end of the spermapore plate (Figs 1H, 3B), situated proximally in the dorsal compartment of the genital chamber (Fig. 4B). Spermatheca thin-walled (Fig. 1G), very fragile, its duct greatly coiled; spermatophore only observed in one female (Fig. 1G: the structure figured may correspond to two simple spermatophores or to one more complex spermatophore).

Dimensions: *Male holotype*: BL = 1.7 mm; FW = 1820 μ m; FWw = 650 μ m; FW/FWw = 2.8; HW = 1510 μ m; F = 342 μ m; T = 720 μ m; t1 = 270 μ m; t2 = 45 μ m; t3 = 54 μ m; IO/D = 1.41. – *Female allotype*: BL = 1.8 mm; FW = 1750 μ m; FWw = 650 μ m; FW/FWw

= 2.7; HW = 1440 μ m; F = 348 μ m; T = 715 μ m; t1 = 260 μ m; t2 = 47 μ m; t3 = 51 μ m; IO/D = 1.44.

Distribution: Mexico, Morelos state, mountains of the Sierra de Huautla Biosphere Reserve, on rock outcrops (but most known specimens collected in Malaise traps without indication of biotope or microhabitat).

Type locality: Mexico, Morelos state, Sierra de Huautla Biosphere Reserve, 2.5 km N and 4 km W of the Centro de Educaci3n Ambiental e Investigaci3n Sierra de Huautla (CEAMISH), 940 m, 18° 27'.671 N, 99° 02'.475 W.

Remarks: The new species seems to be related to a group of North and Middle American species characterized by distally elongated phallic structures with proximal insertion of a V-shaped pair of basal struts. The following species listed by Mockford (2011) show this type of male genitalia: *P. albipalpus* Mockford, 2011 (Mexico), *P. apache* Mockford, 2011 (Southwestern USA), *P. flexuosus* Mockford, 2011 (Guatemala), *P. maculatus* García Aldrete, 1993 (Mexico, USA), *P. oculatus* Gurney, 1943 (Mexico, USA), *P. poblanus* Mockford, 2011 (Mexico), *P. regiomontanus* Mockford, 2011 (Mexico), *P. squamatus* Mockford, 2011 (Mexico), *P. subterraneus* Mockford, 2011 (USA: Texas). In these species the arms of the basal struts are anteriorly directed, as in all other

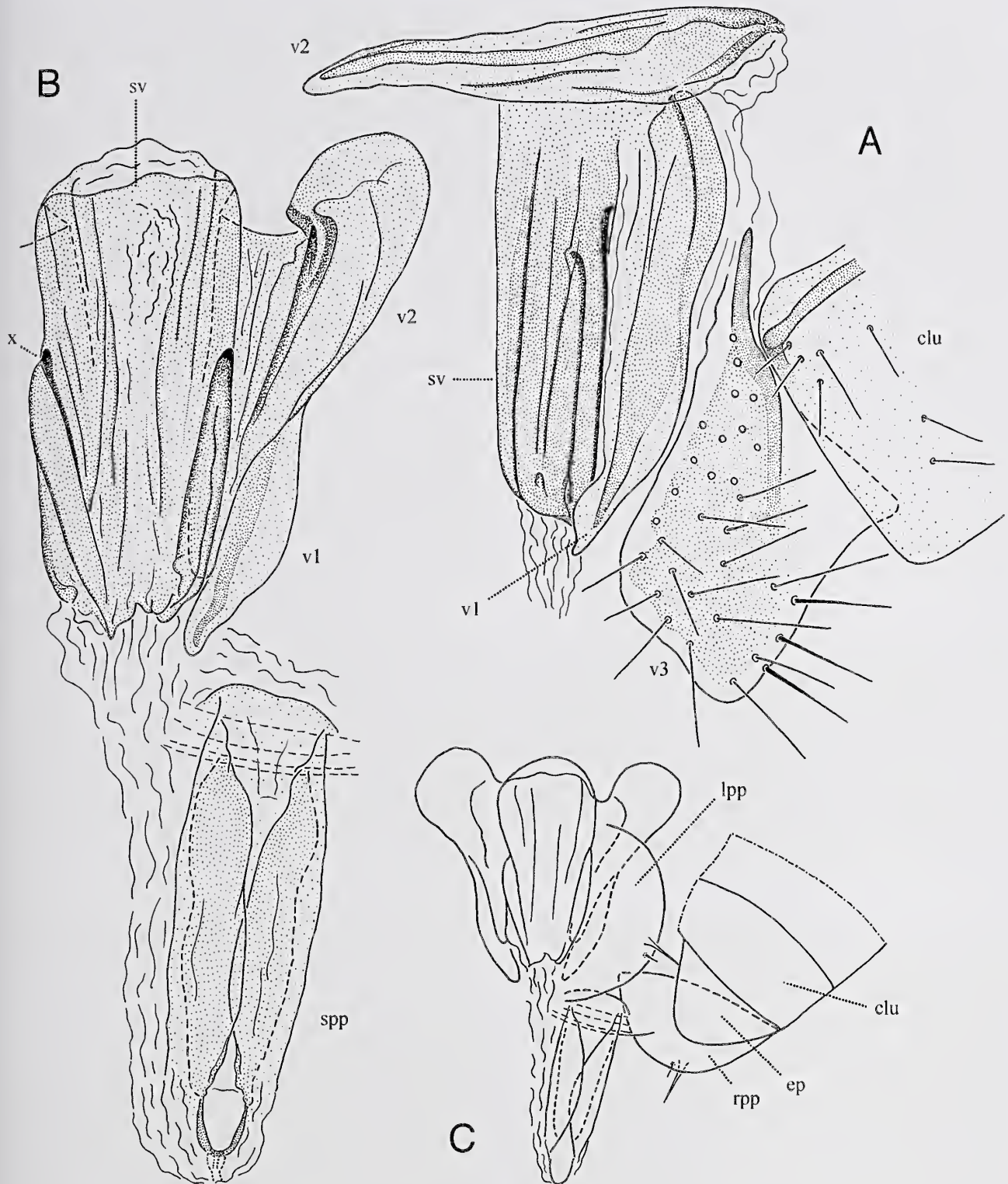


Fig. 3. *Psyllipsocus stupendus* sp. nov. (A) Female paratype (no. 8163), left latero-ventral part of clunium (ventral view), left ovipositor valvulae (v2 spread out) and sclerotized part of vagina (ventral to ventro-lateral view, somewhat deformed by slide mounting), see also Fig 4C. (B) Female paratype (no. 8164), right v1 and v2, sclerotized part of vagina and evaginated spermapore plate (dorsal view; i.e. direct view on ventral side of spermapore plate), see also Figs 3C and 4E. (C) Schematic representation of dissected abdominal apex of female no. 8164, see also Figs 3B and 4E. Abbreviations: clu = clunium; ep = epiproct; lpp = left paraproct; rpp = right paraproct; spp = spermapore plate; sv = sclerotized part of vagina; v1, v2, v3 = first (ventral), second (dorsal) and third (external) ovipositor valvulae respectively; x = joint-like structure in sclerotized lateral vaginal wall.

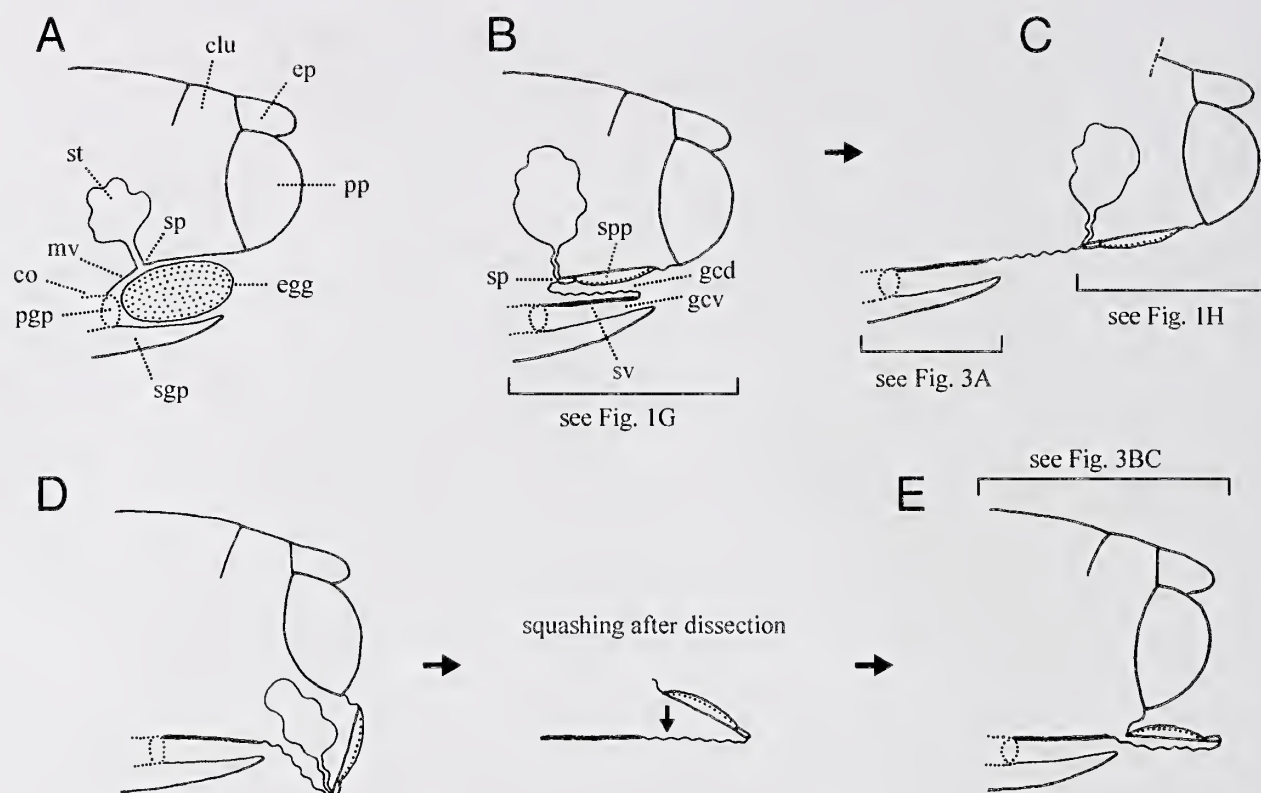


Fig. 4. Schematic representation of female abdominal apex, lateral view (ovipositor valvulae not shown). (A) General scheme of the abdominal apex of a typical female psocid, with egg in position for fertilization (modified after Weber, 1931 and Badonnel, 1951). (B-E) *Psyllipsocus stupendus* sp. nov., with indication of non-schematic figures showing further details. (B) Normal resting position (females no. 8162 and 8163), ventral side of spp marked with a dotted line (lumen of gcd much exaggerated). (C) Female no. 8163, after dissection. (D) Female no. 8164, with evaginated gcd (artifact? – see Discussion). (E) Same female after dissection. Abbreviations: clu = clunium; co = common oviduct; ep = epiproct; gcd = genital chamber, dorsal compartment; gcv = genital chamber, ventral compartment; mv = membranous vagina; pgp = primary gonopore (opening of common oviduct); pp = paraproct; sgp = subgenital plate; sp = spermatheca; sv = sclerotized part of vagina.

species of the genus that have well-developed basal struts. In *P. stupendus*, the structures which are here considered as homologous to the basal struts (see description) are posteriorly directed (forming a posteriorly opened V), probably due to the presence of extremely elongated phallic sclerites. The brachypterous species *P. kintpuashi* Mockford, 2011, the male of which is not known, may also be related to *P. stupendus*. Its female has some stouter laterodistal setae on v3 and the spermathecal duct is greatly coiled, similar to *P. stupendus*. A tendency to sclerotization of the vaginal wall has never previously been observed in the genus *Psyllipsocus*, and in all known species v2 and v3 are relatively short and membranous or only weakly sclerotized.

In spite of the striking autapomorphic genital characters of *P. stupendus* it is at present not justified to consider this species as a representative of a new genus. Concerning the non-genital structures, it fits well in the genus *Psyllipsocus*, and it is almost certain that this genus

would become paraphyletic by a generic separation of *P. stupendus*. For further discussion see below.

DISCUSSION

In two of the three dissected females of *P. stupendus*, the genitalia were in normal resting position (see Figs 1G, 4B), as in the other alcohol-preserved females of the present material. That of the female no. 8164 show an evaginated dorsal compartment of the genital chamber (Fig. 4D), although this may be an artifact, possibly due to stress during fixation in alcohol. Without detailed observations of copulation and oviposition it is impossible to make a sound functional interpretation of the unusual genital morphology in *P. stupendus*. It may nonetheless be of interest to present some preliminary hypotheses about the functional morphology of the complex male and female genitalic structures in this species.

Fig. 4A shows the standard structure of female terminalia in Psocoptera. In some psocids the vagina (genital

chamber) is subdivided by a membranous transversal fold of its dorsal wall in a ventral main compartment and a smaller dorsal compartment (e. g. *Stenopsocus*, see Badonnel, 1934). The spermathecal duct opens directly into the main compartment (Weber, 1931) or into the dorsal compartment near the distal part of the ventral compartment (Badonnel, 1934, 1951). For fertilization the sperm is released from the spermatheca and reaches the egg when it moves past the spermapore (Fig. 4A).

In the female of *P. stupendus* the dorsal wall of the genital chamber is transversally double-folded; the ventral compartment is dorsally delimited by the sclerotized part of the vagina; the dorsal compartment is ventrally delimited by a thin membrane and dorsally by the elongate spermapore plate which bears proximally the opening of the spermathecal duct (Fig. 4B). In the resting position, the distal end of the spermapore plate slightly surpasses the posterior end of the sclerotized vaginal wall (Figs 1G, 4B). The situation after dissection of the terminalia (Fig. 4C) and the observation of the evaginated dorsal compartment in the female no. 8164 (Fig. 4DE) show that the membranous ventral wall of the dorsal compartment is attached to the distal end of the sclerotized part of the vaginal wall and entirely separated from the sclerotized dorsal wall of the ventral compartment. Thus, the position of the spermapore plate may vary during copulation and oviposition depending on the extent of evagination of the eversible dorsal compartment.

Assuming that the egg passes through the ventral compartment while female genitalia are in resting position (Fig. 4B), it cannot enter in direct contact with the spermapore for fertilization. In this case, the sperm released from the spermatheca would have to swim toward the distal end of the spermapore plate before reaching the egg, probably passing between the lateral bulges of the spermapore plate which contain glandular tissue (Fig. 3B). Fertilization of the eggs seems therefore more complicated than in the standard situation, due to the presence of the sclerotized proximal part of the vaginal wall.

The presence of a pair of strongly sclerotized, apically curved and pointed phallic claspers (Fig. 2C), previously unknown in the genus *Psyllipsocus*, suggests that the sclerotized part of the vagina may have a protective function against traumatic effects of copulation, reminiscent of particular sclerotized structures associated with the vulvar area in Miridae (Heteroptera) which are interpreted as a defence system for the female against potential wounding by the male organ (Pluot-Sigwalt & Matocq, 2006). But the sclerotized part of the vagina may also provide new anchoring sites on which males can hold the mate by using their unique phallic claspers. Alternatively, it is also possible that the sclerotized vagina forms a tube-like functional unit together with the sclerotized first and second ovipositor valvulae. The presence of much reduced and weakly sclerotized v1 and v2 in all other species of *Psyllipsocus* suggests that these ovipositor valvulae may have a particular function in

P. stupendus, possibly in combination with the adjacent sclerotized vaginal wall.

In the genus *Neotrogla* Lienhard, 2010, belonging to the related trogiomorphan family Prionoglarididae, structures associated with the spermapore are inserted deep into the male genital chamber during copulation (Yoshizawa *et al.*, 2014), which suggests the possibility of a somewhat similar mechanism in *P. stupendus*. The close contact between the female spermapore and the opening of the male seminal duct, indispensable for the transmission of the spermatophore in the suborder Trogiomorpha (Klier, 1956; Yoshizawa *et al.*, 2014) may be obtained in *P. stupendus* by evagination of the dorsal compartment of the female genital chamber and the shallow insertion of the spermapore plate into the male genitalia. During copulation the phallic claspers may drag the extendable part of the female genitalia into the male body. An example of female genitalia shallowly inserted into the male abdomen in this way is known in the cricket *Gryllus bimaculatus* De Geer, 1773; in this species the female copulatory papilla, bearing the opening of the spermathecal duct, is protruded and enters the male genital cavity where genital coupling is achieved (Sakai & Kumashiro, 2004).

Thus, the unique structures of male and female genitalia in *P. stupendus* may result from a reproductive biology which differs considerably from that of the other species of the genus. A special form of selective pressure based on sexual selection may be at the origin of the very particular genital structures in this species, while the natural (ecological) selection remains similar to most other species of *Psyllipsocus*, favouring the uniform general morphology (see the similar hypotheses for Zoraptera in Mashimo *et al.*, 2014).

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From the shadows of the past: Moricand senior and junior, two 19th century naturalists from Geneva, with their newly described taxa and molluscan types

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Abstract: Stéfano Moricand (1779-1854) and his son Jacques (1823-1877) were amateur scientists active in Geneva. Moricand senior was interested in botany, mineralogy, entomology, and malacology. Between 1820-1847 he published 11 papers on botany, in which he described 110 taxa (including three genera). From 1834-1851 six papers appeared from his hand in which he introduced 72 malacological taxa. Moricand junior published only four malacological papers within a relatively short time (1853-1860), with 16 new species. Biographies and a bibliography, together with a list of their newly introduced taxa, are given for both. The history of their malacological collection and their contacts with other contemporary malacologists are presented, including brief data on J. S. Blanchet (1807-1875) and A. Brot (1821-1896) who were closely linked to this collection, which covered both terrestrial and freshwater molluscs. The type material present in the Muséum d'histoire naturelle in Geneva, of the molluscan, non-Orthalicoid taxa of S. and J. Moricand is figured, complementary to Breure, 2016 (Mollusca, Orthalicoida).

Keywords: biography - bibliography - Bivalvia - Gastropoda - Mollusca - Plantae.

INTRODUCTION

The 'golden age' for collecting of natural history objects started soon after the last of the Napoleonic Wars and ended a century later with the outbreak of the First World War (Danee, 1966; Pearce, 1995). It was also the era in which natural history museums were founded in different European countries (e.g., Gijzen, 1938; Bennet, 1995; Cailliez, 1995; Holthuis, 1995; Kazubski, 1996; Alexander & Alexander, 2008). Nevertheless, the collections of quite a number of naturalists from this era have subsequently been lost. Other collections were dispersed through auction sales, e.g., at the auction house of Stevens in London (Dance, 1986), or through dealers like Gêret in Paris (Rowson & Wood, 2015). Sometimes (parts of) collections are re-discovered after authenticating handwriting on labels with letters in archives (e.g., Audibert, 2011). While working in the Muséum d'histoire naturelle in Genève, it became apparent that its collections have several historically important components, which have partly been documented (e.g., Mermod, 1947, 1950, 1951, 1952; Mermod & Binder, 1963; Cailliez & Finet, 1997). However, regarding Stéfano Moricand (Moricand senior), one of the founding fathers of the museum,

hardly anything was known (but see Cailliez, 1995), and his work, and that of his son Jacques Moricand (Moricand junior), remained in the shadows of the past. The aim of this paper is to present new biographical data, their bibliographies, a list of new taxa described by them, and a list of eponyms, together with some data on personalities linked to Moricand senior and junior.

METHODS

Abbreviations used for depositories of type material: ANSP, Academy of Natural Sciences, Philadelphia, U.S.A.; MHNG-INVE, Muséum d'histoire naturelle, Department of Invertebrates, Geneva, Switzerland; MCZ, Museum of Comparative Zoology, Harvard University, Cambridge (Mass.), U.S.A.; MNHN, Muséum national d'Histoire naturelle, Paris, France; NMB, Naturhistorisches Museum Basel, Basel, Switzerland; SMF, Senckenberg Natur-Museum, Frankfurt am Main, Germany; USNM, Smithsonian Museum, Washington, U.S.A.

BIOGRAPHIES

Moïse Etienne (Stéfano) Moricand (1779-1854)

Moïse Etienne, better known as Stéfano (Fig. 1), was born on 18 December 1779 in Geneva as the eldest son of Christ Moricand and Jeanne Alexandrine Maudry. The Moricand family may be traced back in Geneva at least five generations backwards to the early 17th century. At the age of 12 Stéfano was sent by his father to Italy and became involved in the watches commerce. He travelled throughout Italy, in particular the regions of Tuscany, Naples and Venice, where he started to collect plants, butterflies, shells, minerals, and made contact with several Italian scientists. When he returned to Geneva in 1814, he was an early member of the Société des Naturalistes, which later became the Société helvétique des sciences naturelles. In Geneva he continued his friendship (*teste* Beaujean, 2008: 9) with the well-known botanist A.P. de Candolle (1778-1841), who stimulated him to pursue his botanical studies, which resulted in Moricand's *Flora Veneta* (see bibliography below), of which only the first volume appeared. Later he financed, together with De Candolle, Ph. Mercier and Ph. Dunant, two collecting journeys to respectively Puerto Rico (executed by Heinrich Wydler) and Mexico (by the Belgian explorer Jean Louis Berlandier) (Ritter, 1855: vi; see also Bennicoff, 2014; Anonymous, 2015c). Berlandier not only collected plants but also shells and other animals. Moricand was also author of the *Plantes Nouvelles d'Amérique* (Moricand 1834-1847), in which he described many plants new to science and for which he largely benefited of the collections purchased to the Spanish botanist José Antonio Pavón (plants from Peru and Chili), Jean Louis Berlandier (plants from Mexico and USA) and the Swiss botanist Jacques Samuel Blanchet (plants from Brazil).

In daily life he was probably active as businessman in the watch and jewellery industry (see e.g. Archinard Bovy, 1848), and it is assumed that all natural history related work was done in his spare time (Stafleu & Cowan, 1981: 583).

Moricand was one of the founding members of the Muséum d'histoire naturelle in 1818, for which he was active on the administrative board and acted a few years as treasurer and secretary (Ritter, 1855: vii). He also became a 'membre ordinaire' of the Société de Physique et d'Histoire Naturelle de Genève in 1818 (Anonymous, 1821: viii); he was listed as 'horloger et naturaliste' (Wartmann, 1890: 17). His first contribution to the scientific papers published in the society's 'Mémoires' appeared in the first volume (Moricand & Soret, 1822), dealing with minerals stored in his own collection. From then on, his name can be found quite regularly as a contributing author to this journal. Each volume of this journal consisted of two parts, which, however, appeared irregularly. Also, there was sometimes considerable time lag between the moment the paper was read during one

of the meetings of the society and the moment it appeared in print.

Probably Moricand's collection was based to a great extent on material he received from the Swiss collector Jacques Samuel Blanchet (*8 May 1807, Moudon - †20 March 1875, Vevey; Fig. 2), who became interested in botany during his early education in Vevey. In 1828 he decided to emigrate to Brazil, where he started to work for the Swiss in- and export firm Gex & Decosterd, who had established a branch in [San Salvador de] Bahia (see also Veyrassat, 1993: 144). In his spare time he made excursions in the surroundings of the city and soon began shipping collections of plants, fungi, bryophytes, mammals and molluscs to different naturalists in Geneva. From several of Moricand's papers it might be concluded that he received living molluscs from Blanchet, or alternatively that the latter was a keen observer sending Moricand notes on e.g. the colours of the living animal. It cannot be excluded that the majority of the material was not collected by Blanchet himself, but rather by paid collectors (Anonymous, 2015b), which was a common practice in several of the 19th century field missions. Between 1833 and 1847 Blanchet employed a local man, a 'gaucho' named Manoel, who collected for him on the south coast of the state Bahia, but also in some other places, e.g. the Serra Jacobina and along the Río São Francisco (Anonymous, 2015a). Not only Moricand described new species of plants and molluscs based on material sent by Blanchet. Other researchers in Geneva (e.g., Pictet, 1843) also based descriptions of new taxa on the collections gathered in Brazil. Moricand was a corresponding member of different scientific societies in Italy, France, Russia, Germany, etc. He also established personal contacts with various contemporary scientists. Most of them sent part of their type material to him, thus eventually enriching the collection of the Geneva museum (see below and Breure, 2016).

In his private life, he married on 17 July 1822 with Caroline Jacquet (*31 January 1799, Geneva - †17 December 1869, Chouigny). They had four children, two sons and two daughters. Stéfano Moricand died on 26 June 1854 at his home in Chouigny, near Geneva. Obituaries were published by e.g. Anonymous (1854: 106-107), and Ritter (1855: v-vii); a partial bibliography was given by F. Cavillier in Briquet (1940: 487-490).

Jacques André Moricand (1823-1877)

Born as the eldest son on 15 December 1823 in Geneva, he seems to be the only member of the family who showed some interest in natural history. Only few data are known of him, viz. he finished education in 1843 to become a merchant; in 1860 he became a stockbroker (Stelling-Michaud, 1975: 593). He may have actively curated his father's collection, and he published some papers on South American land and freshwater molluscs



Figs 1-3. Portraits. (1) S. Moricand, at unknown but probably young age (coll. MHNG). (2) J.S. Blanchet (after García Polo, 2015). (3) A. Brot (modified from Campos, 2013: 255).

(see below). Likely he was in contact with persons who supplied him with some new material, e.g. Marius Porte (?-1866), who travelled in South America and send him material from Peru, evidenced from his labels (Crosse, 1866; Breure, 2016). In his private life he remained unmarried and died 10 July 1877 in Chouigny.

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Remarks: The publication dates of the botanical publications have been taken from Stafleu & Cowan (1981: 583). See otherwise the notes in the Appendix.

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- 1820a – Flora Veneta, seu enumeratio plantarum circa Venetiam nascentium, secundum methodum Linneanum disposita, 1. Pasquod, Genevae/Paris, 439 pp. [July].
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- 1822 – [Moricand S. & Soret L.] Mémoire sur plusieurs cristallisations nouvelles de Strontiane sulfatée. *Mémoires de la Société de physique et d'histoire naturelle de Genève* 1(2): 309-327, pl.
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- 1830 – Plantae americanae rariores: descriptae et iconibus illustratae. Barbezat, Genève, 12 pp. – Remarks. See Stafleu & Cowan, 1981: 583 for details about this publication and the validity of the new names introduced.
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- 1834b – Note sur quelques espèces nouvelles de coquilles terrestres. *Mémoires de la Société de physique et d'histoire naturelle de Genève* 6(2): 537-543, pl. 1.
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- 1836b [1834-1847, part 1 + 2] – Plantes nouvelles d'Amérique: 1-24, pls 1-16. Fick, Genève. – Remarks. These two parts were probably issued together, consisting of 1834a, 1835 and set from fresh type; see Stafleu & Cowan, 1981: 583.
- 1837a [1834-1847, part 3] – Plantes nouvelles d'Amérique: 25-40, pls 17-26. Fick, Genève.

- 1837b [1834-1847, part 4] – Plantes nouvelles d'Amérique: 41-56, pls 27-38. *Fick, Genève*.
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- 1839 [1834-1847, part 5] – Plantes nouvelles d'Amérique: 57-76, pls 39-50. *Fick, Genève*.
- 1840 [1834-1847, part 6] – Plantes nouvelles d'Amérique: 77-96, pls 51-60. *Fick, Genève*.
- 1841a – Second supplément au mémoire sur les coquilles terrestres et fluviatiles, envoyées de Bahia par M. J. Blanchet. *Mémoires de la Société de physique et d'histoire naturelle de Genève* 9(1): 57-64, pl. 4.
- 1841b [1834-1847, part 7] – Plantes nouvelles d'Amérique: 97-116, pls 61-70. *Fick, Genève*.
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J. Moricand

- 1853 – Description d'une espèce du genre *Planorbis*. *Journal de Conchyliologie* 4: 37-38.
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- 1858 – Description de quelques coquilles nouvelles. *Revue et magasin de zoologie pure et appliquée* (2) 10: 449-455, pls 13-15.
- 1860 – Note sur la *Melanopsis Brasiliensis*. *Journal de Conchyliologie* 8: 301-304, pl. 12.

NEW TAXA INTRODUCED

In the section on Moricand names taxa are listed alphabetically following their specific name, or their varietal name in case of varieties. Plants and animals are listed separately. For the latter the availability of the names has been checked with the key provided by Lingafelter & Yanega (2012) as clarification for ICZN Art. 31.2 juncto 45.6 (ICZN, 1999). The collector, or supplier of specimens, is given between square brackets after the type locality. The current classification at family level (for plants taken from IPNI, 2014) is given between brackets. For the molluscan taxa depositories of type material are listed as far as known, but only the material in

Geneva has been examined during this study; the number of specimens is given between parentheses, followed by references to figures between square brackets (taxa belonging to the superfamily Orthalioidae are dealt with in Breure, 2016 and referred to as [B:]). The classification of molluscan taxa was quite unstable in the early 19th century, and Moricand senior often listed e.g. alternative taxon names; in such cases only the first mentioned has been listed.

Plantae

- abruptum*, *Commilobium*, S. Moricand, 1841: 98, pl. 62. Type locality: [Brazil] serra Acurua, provincia Bahiensis [Blanchet] (Fabaceae).
- aculeatissima*, *Argemone mexicana* var., S. Moricand ex Prain, 1895: 367. No type locality (Papaveraceae).
- acuminata*, *Serronia*, S. Moricand, 1840: 86, pl. 57. Type locality: [Brazil] circa Bahiam [Blanchet] (Piperaceae).
- acuminatum*, *Cynanchum*, S. Moricand, 1820a: 128. Type locality: [Italy] inter Mestre e la Mira (Apocynaceae).
- acuruana*, *Bauhinia* (*Pauletia*), S. Moricand, 1840: 77, pl. 51. Type locality: [Brazil] Serra Acurua, provincia Bahiensis [Blanchet] (Fabaceae).
- agastachya*, *Dalea*, S. Moricand, 1839: 65, pl. 44. Type locality: [U.S.A.] Texas [Berlandier] (Fabaceae).
- albiflora*, *Ipomoea*, S. Moricand, 1841b: 114, pl. 70. Type locality: [Brazil] in provincia Bahiensis, prope Igreja Vehlha [sic, Velha] [Blanchet] (Convolvulaceae).
- alopecurus*, *Dalea*, S. Moricand, 1836a: 250, pl. 8. Type locality: in Mexico, in las Cordilleras de Guchilapa (Fabaceae).
- australis*, *Saxifraga*, S. Moricand, 1820a: 431. Type locality: [Italy] prope Neapoli (Saxifragaceae).
- bahiensis*, *Hiraea*, S. Moricand, 1841b: 107. Type locality: [Brazil] Nazareth das Farinhas, prope Bahiam [Blanchet] (Malpighiaceae).
- bahiensis*, *Alsodeia*, S. Moricand, 1839: 68, pl. 46. Type locality: [Brazil] circa Bahiam [Blanchet] (Violaceae).
- bahiensis*, *Patagonula*, S. Moricand, 1847: 144, pl. 86. Type locality: [Brazil] serra Acurua [sic], provincia Bahiensis [Blanchet] (Boraginaceae).
- bahiensis*, *Simaba*, S. Moricand, 1836a: 251, pl. 9. Type locality: [Brazil] circa Bahiam [Blanchet] (Simaroubaceae).
- barbinervis*, *Laplacea*, S. Moricand, 1830: 3, pl. 2. Type locality: [Ecuador] in Peruvia prope Guayaquil (Theaceae). – Remarks. Re-published in S. Moricand, 1836a: 256, pl. 11.
- bejariense*, *Trifolium*, S. Moricand, 1834a: 530, pl. 2. Type locality: in Mexico [Mexico] circa Bejar [Berlandier] (Fabaceae).
- berlandierianus*, *Hibiscus*, S. Moricand, 1830: 8, pl. 6. Type locality: in Republica Mexicana, prope Tampico

- de las Tamaulipas [Berlandier] (Malvaceae). – Remarks. Re-published in S. Moricand, 1836a: 262, pl. 15.
- bierosa*, *Hiraea*, S. Moricand ex Jussieu, 1840: 260. Type locality: Brasilia (Malpighiaceae).
- blanchetiana*, *Hiraea*, S. Moricand, 1841b: 104. Type locality: Guiana gallica [French Guiana] (Malpighiaceae).
- blanchetiana*, *Eichleria*, S. Moricand ex Progel in Martius & Eichler, 1877 [1872-1877]: 518. Type locality: in prov. Bahiensi [Blanchet] (Oxalidaceae).
- blanchetianus*, *Dipteracanthus*, S. Moricand, 1847: 163. Type locality: [Brazil, Bahia] Igreja Velha [Blanchet] (Acanthaceae).
- blanchetii*, *Jacquemontia*, S. Moricand, 1837b: 41, pl. 27. Type locality: [Brazil] in provincia Bahiensis [Blanchet] (Convolvulaceae).
- blanchetii*, *Ottonia*, S. Moricand, 1840: 86. Type locality: [Brazil] circa Bahiam [Blanchet] (Piperaceae).
- brasiliana*, *Luziola*, S. Moricand, 1840: 94. Type locality: [Brazil] ripas flumine S. Francisco, prope Utinga (Poaceae).
- cernua*, *Aniseia*, S. Moricand, 1837a: 56, pl. 38. Type locality: [Brazil] circa Bahiam [Blanchet] (Convolvulaceae).
- cordatus*, *Evolvulus*, S. Moricand, 1847: 137, pl. 87. Type locality: Brasilia [Gardner] (Convolvulaceae).
- cordifolia*, *Heteropterys*, S. Moricand, 1841b: 108, pl. 66. Type locality: [Brazil] in provincia Bahiensis [Blanchet] (Malpighiaceae).
- cordifolius*, *Cryptocarpus*, S. Moricand, 1838: 75, pl. 50. Type locality: [Ecuador] in Peruvia prope Huyaquil [Guayaquil] [Pavon] (Nyctaginaceae).
- curvifolia*, *Ichthyothere*, S. Moricand, 1847: 150, pl. 89. Type locality: in Brasilia ad Igreja velha [Blanchet] (Asteraceae).
- daphnoides*, *Evolvulus*, S. Moricand, 1839: 59, pl. 40. Type locality: [Brazil] in paludibus Ithabira dictis in provincia Bahiensis [Blanchet] (Convolvulaceae).
- diffusa*, *Dalea*, S. Moricand, 1834a: 536, pl. 6. Type locality: in nova Hispania [Pavon] (Fabaceae).
- echioides*, *Evolvulus*, S. Moricand, 1837b: 55, pl. 37. Type locality: [Brazil, Bahia] Serra Jacobina [Blanchet] (Convolvulaceae).
- elegans*, *Evolvulus*, S. Moricand, 1837b: 53, pl. 36. Type locality: [Brazil, Bahia] Serra Jacobina [Blanchet] (Convolvulaceae).
- eriocephala*, *Ipomoea*, S. Moricand, 1837b: 43, pl. 29. Type locality: [Brazil] circa Bahiam [Blanchet] (Convolvulaceae).
- evolvuloides*, *Ipomoea*, S. Moricand, 1837b: 47, pl. 32. Type locality: [Brazil] circa Bahiam [Blanchet] (Convolvulaceae).
- excentrica*, *Dorstenia*, S. Moricand, 1840: 92: pl. 59. Type locality: in Mexico circa Tampico de Tamaulipas [Berlandier] (Moraceae).
- filiformis*, *Sida*, S. Moricand, 1830: 10, pl. 8. Type locality: [Mexico] circa Tampico de Tamaulipas (Malvaceae).
- flemmingioides*, *Zornia*, S. Moricand, 1844: 127, pl. 76. Type locality: [Brazil, Bahia] Serra Jacobina [Blanchet] (Fabaceae).
- floribunda*, *Ipomoea*, S. Moricand, 1837b: 46, pl. 31. Type locality: [Brazil] in provincia Bahiensis [Blanchet] (Convolvulaceae).
- flexuosa*, *Bauhinia* (*Caulotretus*), S. Moricand, 1840: 80, pl. 53. Type locality: [Brazil] Serra Acurua, provincia Bahiensis [Blanchet] (Fabaceae).
- floribunda*, *Alsodeia*, S. Moricand, 1839: 70, pl. 47. Type locality: [Brazil] circa Bahiam [Blanchet] (Violaceae).
- frankenoides*, *Evolvulus*, S. Moricand, 1837b: 49, pl. 33. Type locality: [Brazil] in provincia Bahiensis [Blanchet] (Convolvulaceae).
- gardneriana*, *Zornia*, S. Moricand, 1844: 129, pl. 77. Type locality: in Brasilia, prov. Piaui [Gardner] (Fabaceae).
- geminiflora*, *Pavonia*, S. Moricand, 1844: 120, pl. 73. Type locality: [Brazil] circa Bahiam [Blanchet] (Malvaceae).
- gnaphaloides*, *Evolvulus*, S. Moricand, 1839: 61, pl. 41. Type locality: [Brazil, Bahia] Serra Acurua [Blanchet] (Convolvulaceae).
- gypsophiloides*, *Evolvulus*, S. Moricand, 1837b: 52, pl. 35. Type locality: [Brazil] in deserto (Sertao) Bahiense [Blanchet] (Convolvulaceae).
- hebeclada*, *Hirtella*, S. Moricand in A.P. de Candolle, 1825: 529. Type locality: in Brasilia (Chrysobalanaceae).
- helichrysoides*, *Evolvulus*, S. Moricand, 1844: 134, pl. 80. Type locality: [Brazil, Bahia] Serra Jacobina [Blanchet] (Convolvulaceae).
- heptaphyllum*, *Centrosema*, S. Moricand, 1840: 96, pl. 61 [1841]. Type locality: [Brazil] ad ripas flumine S. Francisco, prope Utinga [Blanchet] (Leguminosae).
- Herpetacanthus* S. Moricand, 1847: 159. (Acanthaceae).
- hymenaeifolia*, *Copaifera*, S. Moricand, 1834a: 529, pl. 1. Type locality: in insula Cubae [Ramon de la Sagra] (Fabaceae).
- intermedia*, *Brongniartia*, S. Moricand, 1830: 1, pl. 1. Type locality: in montibus circa Mexico (Fabaceae). – Remarks. Re-published in S. Moricand, 1836a: 254, pl. 10.
- intermedius*, *Physostemon*, S. Moricand, 1839: 62, pl. 42. Type locality: in Brasilia prope villa di Barra et (...) prope Itapuam [Blanchet] (Capparaceae).
- involutrata*, *Helicteres*, S. Moricand, 1841b: 100, pl. 63. Type locality: [Brazil, Bahia] circa villa di Barra [Blanchet] (Sterculiaceae).
- italicum*, *Verbascum*, S. Moricand, 1820a: 116. Type locality: [Italy] Fusine (Scrophulariaceae).
- Jacobinia* S. Moricand, 1847: 156. (Acanthaceae).
- jacobinus*, *Evolvulus*, S. Moricand, 1844: 135, pl. 81. Type locality: [Brazil, Bahia] Serra Jacobina [Blanchet] (Convolvulaceae).

- latifolia*, *Krameria*, S. Moricand, 1839: 63, pl. 43. Type locality: in Brasilia prope villa di Barra [Blanchet] (Krameriaceae).
- lavateroides*, *Hibiscus*, S. Morieand, 1830: 9, pl. 7. Type locality: [Mexico] prope Tampico de las Tamaulipas [Berlandier] (Malvaceae). – Remarks. Re-published in S. Moricand, 1836a: 263, pl. 16.
- lepida*, *Jacobinia*, S. Moricand, 1847: 157, pl. 92. Type locality: in Brasilia, prov. Bahiensis [Blanchet] (Acanthaceae).
- leucocephala*, *Cordia*, S. Moricand, 1847: 148, pl. 88. Type locality: [Brazil, Bahia] serra Acuara [Blanchet] (Boraginaceae).
- linoides*, *Evolvulus*, S. Moricand, 1844: 139, pl. 83. Type locality: [Brazil] prov. Bahiensis loco dicto Pouço d'Areia [Blanchet] (Convolvulaceae).
- longiflorus*, *Herpetacanthus*, S. Morieand, 1847: 159, pl. 93. Type locality: [Brazil] prov. Bahiensis [Blanchet] (Acanthaceae).
- longifolia*, *Dorstenia*, S. Moricand, 1840: 90, pl. 58. Type locality: [Brazil] in provincia Bahiensis [Blanchet] (Moraceae).
- lucidum*, *Solanum*, S. Moricand, 1837a: 26, pl. 18. Type locality: [Brazil] in provincia Bahiensis [Blanchet] (Solanaceae).
- luxurians*, *Ipomoea*, S. Moricand, 1839: 58, pl. 39. Type locality: Serra Açurua, provinc. Bahien. [Blanchet] (Convolvulaceae).
- macrostachya*, *Dalea*, S. Moricand, 1834a: 534, pl. 5. Type locality: [Mexico] in nova Hispania (Fabaceae).
- macrostachya*, *Salicornia*, S. Moricand, 1820a: 2. Type locality: [Italy] Malamocco (Amaranthaceae).
- manoelii*, *Solanum*, S. Moricand, 1837a: 27. Type locality: [Brazil] in provincia Bahiensis [Blanchet] (Solanaceae).
- maritimus*, *Juncus*, S. Moricand, 1820a: 172. Type locality: [Veneto] in paludosis maritimus (Juncaceae).
- mexicana*, *Larrea*, S. Moricand, 1839: 71, pl. 48. Type locality: [Mexico] prope St. Louis di Potosi [Berlandier] (Zygophyllaceae).
- mexicana*, *Platanus*, S. Moricand, 1830: 12, pl. 10. Type locality: circa Mexico [Berlandier] (Platanaceae). – Remarks. Re-published in S. Morieand, 1837a: 39, pl. 26.
- mexicana*, *Sida anomala* [var.], S. Moricand, 1830: 11, pl. 9. Type locality: [Mexico, circa Tampico de Tamaulipas] (Malvaceae).
- micrantha*, *Glechoma hederacea* [var.], S. Moricand, 1820a: 433. Type locality: [Italy] Foro Juliensi prope Montisfalconem (Lamiaceae).
- montana*, *Ipomoea*, S. Moricand, 1837b: 44, pl. 30. Type locality: [Brazil, Bahia] Serra Jacobina [Blanchet] (Convolvulaceae).
- odoratissima*, *Bauhinia* (*Pauletia*), S. Moricand, 1840: 78, pl. 52. Type locality: in Brasilia, prope Nagè, provincia Bahiensis [Blanchet] (Fabaceae).
- paludosum*, *Solanum*, S. Moricand, 1837a: 29, pl. 20. Type locality: [Brazil] circa Bahiam [Blanchet] (Solanaceae).
- pavoniana*, *Ternstroemia*, S. Moricand, 1830: 5, pl. 4. Type locality: in Peruvia (Theaceae). – Remarks. Re-published in S. Morieand, 1836a: 258, pl. 13.
- penicillata*, *Dalea*, S. Moricand, 1839: 66, pl. 45. Type locality: [U.S.A.] Texas, inter Rio della Trinidad et Bexar [Berlandier] (Fabaceae).
- peruviana*, *Malpighia*, S. Moricand, 1841b: 109. Type locality: in Peruvia (Malpighiaceae).
- phyllanthoides*, *Evolvulus*, S. Moricand, 1840: 82, pl. 54. Type locality: [Brazil] in sylvis paludibus Olhos d'agua dictis, provincia Bahiensis [Blanchet] (Convolvulaceae).
- pogogenum*, *Solanum*, S. Moricand, 1837a: 25. Type locality: in Brasilia, provincia Bahiensis [Blanchet] (Solanaceae).
- polytrichum*, *Solanum*, S. Moricand, 1837a: 32. Type locality: [Brazil] circa Bahiam [Blanchet] (Solanaceae).
- prostrata*, *Pavonia*, S. Moricand, 1844: 119, pl. 72. Type locality: [Brazil] circa Japira [Blanchet] et in prov. Alagoas [Gardner] (Malvaceae).
- pseudocordigfra*, *Serapias*, S. Moricand, 1820a: 374. Type locality: [Italy, Venice] Lido e a Treporti (Orchidaceae).
- psoraleoides*, *Dalea*, S. Moricand, 1834a: 533, pl. 4. Type locality: in Mexico prope Cuernavaca (Fabaceae).
- pteroaulon*, *Evolvulus*, S. Moricand, 1844: 140, pl. 84. Type locality: [Brazil] prov. Bahiensis, prope Tamandua [Blanchet] (Convolvulaceae).
- pteropoda*, *Ottonia*, S. Moricand, 1840: 88. Type locality: [Brazil] circa Bahiam [Blanchet] (Piperaceae).
- pulchella*, *Dalea*, S. Morieand, 1836a: 249, pl. 7. Type locality: [Mexico] circa St. Louis de Potosi (Fabaceae).
- pulchra*, *Cuphea*, S. Moricand, 1847: 168, pl. 89. Type locality: [Brazil, Bahia] serra Jacobina [Blanchet] (Lythraceae).
- ramosissimus*, *Thyrsacanthus*, S. Moricand, 1847: 165, pl. 96. Type locality: [Brazil, Bahia] serra Acurua [Blanchet] (Acanthaceae).
- reticulata*, *Lavoisiera*, S. Morieand, 1847: 170, pl. 99. Type locality: [Brazil, Bahia] ad Igreja Velha [Blanchet] (Melastomataceae).
- rosea*, *Salvia pratensis* [var. β], S. Moricand, 1820a: 5. Type locality: [Italy] Cherignago (Labiatae).
- ruiziana*, *Ternstroemia*, S. Morieand, 1830: 4, pl. 3. Type locality: [Ecuador] in Peruvia prope Guayaquil (Theaceae). – Remarks. Re-published in S. Moricand, 1836a: 257, pl. 12.
- sericea*, *Zornia*, S. Moricand, 1844: 126, pl. 75. Type locality: [Brazil, Bahia] serra Jacobina [Blanchet] (Fabaceae).
- setosa*, *Dorstenia*, Moricand, 1841b: 103, pl. 64. Type locality: [Brazil] provincia Bahiensis [Blanchet] (Moraceae).

- speciosus*, *Evolvulus*, S. Moricand, 1837b: 50, pl. 34. Type locality: [Brazil, Bahia] Serra Jacobina [Blanchet] (Convolvulaceae).
- sphaerocarpum*, *Solanum*, S. Moricand, 1837a: 31. Type locality: [Brazil] provincia Bahiensis [Blanchet] (Solanaceae).
- stagnale*, *Solanum*, S. Moricand, 1837a: 34, pl. 23. Type locality: [Brazil] circa Bahiam [Blanchet] (Solanaceae).
- strictissimus*, *Heliotropium*, S. Moricand, 1847: 146, pl. 87. Type locality: [Brazil, Bahia] serra Jacobina [Blanchet] (Boraginaceae).
- subordinatus*, *Styrax*, S. Moricand, 1844: 117, pl. 71. Type locality: in Brasilia prov. Bahiensis [Blanchet] (Styracaceae).
- subsessilis*, *Jacquemontia*, S. Moricand, 1837b: 42, pl. 28. Type locality: [Brazil] provincia Bahiensis [Blanchet] (Convolvulaceae).
- subulata*, *Glechoma*, S. Moricand, 1820a: 432. Type locality: [Veneto] Foro Juliensi prope Montisfalconem (Lamiaceae).
- tampicensis*, *Hibiscus*, S. Moricand, 1830: 7, pl. 5. Type locality: in Republica Mexicana, prope Tampico de las Tamaulipas [Berlandier] (Malvaceae). – Remarks. Re-published in S. Moricand, 1836a: 260, pl. 14.
- tenuifolia*, *Zornia*, S. Moricand, 1844: 132, pl. 79. Type locality: in Brasilia prope S. Thomé prov. Bahiensis [Blanchet] (Fabaceae).
- thomesiana*, *Roupala*, S. Moricand, 1847: 172, pl. 100. Type locality: [Brazil, Bahia] prope S. Thomé [Blanchet] (Proteaceae).
- thomesianus*, *Siphocampylus*, S. Moricand, 1847: 142, pl. 85. Type locality: in Brasilia prope S. Thomé prov. Bahiensis [Blanchet] (Campanulaceae).
- Thysacanthus* S. Moricand, 1847: 165. (Acanthaceae).
- trifoliolata*, *Berberis*, S. Moricand, 1841b: 113, pl. 69. Type locality: in Respublica [sic] mexicana, inter Laredo et Bejar [Berlandier] (Berberidaceae).
- trifoliolata*, *Dalea*, S. Moricand, 1834a: 531, pl. 3. Type locality: in Mexico, la vallée de Toluca [Aleman, Berlandier, Pavon] (Fabaceae).
- varians*, *Pavonia*, S. Moricand, 1844: 122, pl. 74. Type locality: in Brasilia prope Japira [Blanchet] (Malvaceae).
- villosa*, *Prockia*, S. Moricand, 1839: 167, pl. 97. Type locality: in Brasilia prope Tamandua [Blanchet] (Tiliaceae).
- virgata*, *Zornia*, S. Moricand, 1844: 131, pl. 78. Type locality: in Brasilia (...) locus natalis incertus [Gardner] (Fabaceae).

Mollusca

- atrovirens*, *Helix (Cochlohydra)*, S. Moricand, 1836b: 416, pl. 2 fig. 1. Type locality: [Brazil, Bahia] Portao [Blanchet]. Syntypes: MHNG-INVE-64624 (2), MHNG-INVE-78487 (6) (Simpulopsidae) [B: figs 8-10]. – Remarks. Additional syntypes are NMB 1576a (2), 1576b (4).
- aurismuris*, *Helix (Cochlogena)*, S. Moricand, 1838: 141, pl. 3 figs 1-3. Type locality: [Brazil] fazenda de Palmeirinha, entre Caxoeira et Jacobine, province de Bahia [Blanchet]. Syntypes: MHNG-INVE-60683 (44), MHNG-INVE 60686 (48) (Bulimulidae) [B: fig. 44]. – Remarks. Material present as NMB 1404a (10), and NMB 1404b (7) is listed as ‘paratypes’ [syntypes].
- bahiensis*, *Ancylus*, S. Moricand, 1836b: 442. Nomen nudum.
- bahiensis*, *Helix (Cochlogena)*, S. Moricand, 1834b: 541, pl. 1 fig. 6. Type locality: le Brésil dans les bois près de Bahia [Blanchet]. Syntypes: MHNG-INVE-64638 (31) (Odontostomidae) [B: figs 113-114]. – Remarks. Additional syntypes NMB 9612a (9), 9612b (8).
- barilensis*, *Ancylus*, S. Moricand, 1846: 159, pl. 5 figs 30-32. Type locality: [Brazil] lac Baril près de Bahia [Blanchet]. Syntypes: MHNG-INVE-87402 (10) (Ancylidae) [Figs 17-19]. – Remarks. An additional label in a later hand mentions “type / B. H-ck [Hubendick]” but it remains unsure which specimen was selected and we have been unable to find any published lectotype designation. Additional syntypes NMB 6906a (2).
- berlandieriana*, *Helix (Helocogena)*, S. Moricand, 1834b: 537, pl. 1 fig. 1. Type locality: le Mexique, dans la province de Texas [Berlandier]. Syntypes: MHNG-INVE-37027 (7) (Polygyridae) [Figs 41-43]. – Etymology. Named after Jean Louis Berlandier (see also Bennicoff, 2014).
- bilineata*, *Melanopsis crenocarina* [var. γ], S. Moricand, 1841a: 62. Type locality: [Brazil] le Rio de Pedra Branca, province de Bahia [Blanchet]. Syntypes: MHNG-INVE-91240 (3) (Thiaridae) [Fig. 8].
- bipunctata*, *Helix (Helicigona) pyramidella* [var. β], Moricand, 1836b: 419. – Remarks. Not available name (infrasubspecific).
- blanchetiana*, *Helix (Helicigona)*, S. Moricand, 1834b: 539, pl. 1 fig. 3. Type locality: le Brésil, aux environs de Bahia [Blanchet]. Possible syntypes: MHNG-INVE-60674 (16) (Bulimulidae) [B: figs 38-39]. – Remarks. S. Moricand, 1836b: 418 considered this taxon as a variety of *Helix pyramidella* Wagner in Spix, 1827. Additional syntypes NMB 97a (15), NMB 97a' (10). – Etymology. Named after Jacques Samuel Blanchet.
- blanchetianum*, *Cyclostoma*, S. Moricand, 1836b: 442, pl. 2 figs 21-23. Type locality: [Brazil, Bahia] Caxoeira [Blanchet]. Syntypes: MHNG-INVE-91233 (3) (Megalostomidae) [Figs 47-49]. – Remarks. Additional syntypes NMB 597a (7), NMB 597c (6). – Etymology. See above.
- boissieri*, *Helix (Bulimus)*, S. Moricand, 1846: 156, pl. 5 figs 24-25. Type locality: [Brazil] les environs de

- Bahia [Blanchet]. Syntypes: MHNG-INVE-64622 (3) (Simpulopsidae) [B: figs 6-7]. – Remarks. Additional material as syntypes in NMB 1433a (2), 1433b (6). – Etymology. Named after Pierre Edmond Boissier (see Anonymous, 2015d).
- brasiliensis*, *Helix* (*Cochlodonta*) *comboides* [var.], S. Moricand, 1836b: 417; 1841: pl. 5 fig. 5. Type locality: [Brazil, Bahia; Blanchet]. Syntypes: MHNG-INVE-68684 (41) (Streptaxidae) [Figs 58-60]. – Remarks. This is a junior primary homonym of *Helix brasiliensis* Férussac, 1821, see Hausdorf, 2013: 499. Additional syntypes NMB 1523b (7).
- brasiliensis*, *Helix* (*Cochlohydra*), S. Moricand, 1836b: 416. Type locality: [Brazil, Bahia] les forêts de S. Gonsalves [Blanchet]. Syntypes: MHNG-INVE-78488 (9) (Simpulopsidae) [B: figs 15-17]. – Remarks. Other syntypes are present in NMB 8259a (9).
- brasiliensis*, *Melanopsis*, S. Moricand, 1838: 144, pl. 3 figs 12-13. Type locality: [Brazil, Bahia] Villa de Barra [Blanchet]. Syntypes: MHNG-INVE-91238 (2 + subadults) (Pleuroceridae) [Fig. 11]. – Remarks. Some specimens, presumably from the original series, were apparently sent to J.C. Anthony, and are now in the MCZ collection (MCZ 74780). NMB 1171a (5) and NMB 1171b (5) are additional syntypes.
- candidum*, *Helix*, S. Moricand, 1841a: 57, pl. 4 fig. 1. – Remarks. New name for *Helix perspectiva* Wagner in Spix, 1827 non Megerle, 1816; junior homonym of *Solarium candidum* Spix, 1827 (Streptaxidae).
- caracolla*, *Helicina*, S. Moricand, 1836b: 444, pl. 2 figs 24-25. Type locality: [Brazil, Bahia] Almada [Blanchet]. Syntypes: MHNG-INVE-91246 (3) (Helicinidae) [Figs 24-27]. – Remarks. Six specimens are registered as ‘paratypes’ [syntypes] in MCZ 142973; also in ANSP 14600 (6), ANSP 14622 (2), as syntypes, and NMB 3850a (14) as ‘Paratypen’ [syntypes].
- caxapregana*, *Helix*, S. Moricand, 1836b: 426. – Remarks. New name for *Columna maritima* Wagner in Spix, 1827 not *Helix maritima* Draparnaud, 1805; “c’est pourquoi le nom de *H. maritima* ayant été appliqué depuis longtemps à une espèce du midi de la France” (Subulinidae).
- cecileae*, *Bulimus*, J. Moricand, 1858: 452, pl. 14 fig. 4. Type locality: [Peru] Tarapoto. Syntypes: MHNG-INVE-63436 (9) (Bulimulidae) [B: fig. 49].
- chrysostoma*, *Helix* (*Cochlogena*) *rhodospira* [var. β], S. Moricand, 1836b: 428. Type locality: [Brazil] aux environs de Bahia [Blanchet]. Syntypes: MHNG-INVE-60161 (5) (Bulimulidae) [B: fig. 88]. – Additional syntypes NMB 1387b (2), NMB 9616a (4), NMB 9616b (3).
- cimex*, *Planorbis*, S. Moricand, 1838: 143, pl. 3 figs 8-9. Type locality: [Brazil] aux environs de Bahia [Blanchet]. Syntypes: MHNG-INVE-86802 (16) (Planorbidae) [Fig. 14]. – Other material as syntypes in NMB 6892b (3).
- cingulata*, *Melania*, J. Moricand, 1860: 303, pl. 12 fig. 6. Type locality: [Brazil] Rivi re Jaguaripe, pr s Bahia. Syntypes: MHNG-INVE-91245 (8) (Pleuroceridae) [Fig. 13]. – Remarks. Fischer-Piette (1950: 18) recorded “un sp cimen, 35 mm.” (syntype) in the MHNH collection.
- cinnamomeolineata*, *Helix* (*Cochlogena*), S. Moricand, 1841a: 60, pl. 4 figs 6-7. Type locality: [Brazil] la province de Bahia [Blanchet]. Syntypes: MHNG-INVE-64546 (10), MHNG-INVE-64547 (6 + 8 subadults) (Simpulopsidae) [B: fig. 18].
- citrinovitrea*, *Helix* (*Cochlogena*), S. Moricand, 1836b: 436, pl. 2 fig. 19. Type locality: [Brazil] aux environs de Bahia [Blanchet]. Lectotype and paralectotypes: MHNG-INVE-64616 (4 subadults), MHNG-INVE-64617 (1 + 18 subadults) (Simpulopsidae) [B: figs 4-5]. – Additional material as ‘Syntypen’ [paralectotypes] in NMB 1434a (9), NMB 1434b (22).
- coffreana*, *Helix*, S. Moricand, 1841a: 58, pl. 4 figs 2-3. Type locality: [Brazil] la province de Bahia [Blanchet]. (Systrophiidae). – Remarks. Material that could be attributed as type material of this taxon was not found during this study. However, material in NMB 1525a (10) is listed as ‘Paratypen’ [syntypes].
- costulata*, *Unio* (*Monocondylea*), J. Moricand, 1858: 453, pl. 15 fig. 1. Type locality: Br sil. Syntypes: MHNG-INVE-91234 (1) (Unionidae) [Figs 50-53]. – Remarks. Moricand junior wrote “j’en ai re u seulement deux individus”, which is interpreted as two doublets. Only one specimen (doublet), however, could be found in the collection. The specimen was labelled as having been revised by Haas in 1930.
- coxeirana*, *Helix* (*Cochlogena*), S. Moricand, 1836b: 433, pl. 2 figs 7-11. Type locality: [Brazil] Caxoeira, dans la province de Bahia, et dans les bois de St.-Gonsalves [Blanchet]. Syntypes: MHNG-INVE-64548 (3 + 2 subadults) (Bulimulidae) [B: figs 19-21]. – Remarks. See also under *dizona*, *negrescens*, and *trizona*. Additional syntypes NMB 1420a (8), NMB 1420c (7).
- crenocarina*, *Melanopsis*, S. Moricand, 1841a: 61, pl. 4 figs 10-11. Type locality: [Brazil] Rio de Pedra Branca, province de Bahia [Blanchet]. (Thiaridae). – Remarks. Material of this nominate taxon has not been found in the collection during this study; see also under the varieties *bilineata*, *leucostoma*, and *melanostoma*. Material listed as ‘Paratypen’ [syntypes] in NMB 1201a (6), NMB 1201c (7).
- cryptodon*, *Helix* (*Streptaxis*), S. Moricand, 1851: 370, pl. 10 figs 2a-d. Type locality: [Brazil] La province de Bahia. Syntypes: MHNG-INVE-68687 (5) (Streptaxidae) [Figs 80-82].
- decussata*, *Ampullaria*, S. Moricand, 1836b: 445, pl. 2 figs 26-27. Type locality: [Brazil, la province de Bahia. Blanchet]. Syntypes: MHNG-INVE-33485 (2) (Ampullariidae) [Figs 32-33]. – The largest specimen

- (here figured) corresponds to the original figure. “Many (> 10)” specimens are in the MCZ collection, catalogued as ‘paratypes’ [syntypes] and registered MCZ 141866. Other material as syntypes in NMB 1219a (8), NMB 1219b (4).
- dejecta*, *Helix*, S. Moricand, 1836b: 418. – Published as synonym of *Helix* (*Cochlodonta*) *comboides brasiliensis* S. Moricand, 1836, valid under Art. 11.6.1 ICZN; see Hausdorf, 2013: 499.
- delphinae*, *Bulimus*, J. Moricand, 1858: 452, pl. 14 fig. 3. Type locality: [Peru] Tarapoto. Syntypes: MHNG-INVE-63443 (3) (Bulimulidae) [B: fig. 50]. – Etymology. Named after his sister, Delphine Moricand (1826–1907).
- dentifer*, *Planorbis*, J. Moricand, 1853: 37. Type locality: [Brazil] le lac Baril, près Bahia [Blanchet]. Syntypes: MHNG-INVE-86932 (3) (Planorbidae) [Figs 34–36].
- depressissimus*, *Planorbis*, S. Moricand, 1838: 143, pl. 3 figs 10–11. Type locality: [Brazil] aux environs de Bahia [Blanchet]. Syntypes: MHNG-INVE-86940 (many) (Planorbidae) [Figs 15–16]. – Additional syntypes NMB 6891a (3).
- disjunctum*, *Cyclostoma*, S. Moricand, 1846: 158, pl. 5 figs 26–29. Type locality: [Brazil] la province de Bahia [Blanchet]. (Megalostomatidae). – Remarks. Type material of this taxon could not be traced during our study.
- dizona*, *Helix* (*Cochlogena*) *coxeiranus* [var. β], S. Moricand, 1836b: 433, pl. 2 fig. 8. Type locality: [Brazil] Caxoeira, dans la province de Bahia, et dans les bois de St.-Gonsalves [Blanchet]. – Remarks. Not available name (infrasubspecific).
- edentula*, *Helix comboides* [var.], S. Moricand, 1846: 154. No type locality. Syntypes: MHNG-INVE-68683 (37, partly subadult) (Streptaxidae) [Figs 61–63]. – Remarks. The specimens are accompanied by a label that states “Bahia, Blanchet”. Additional syntypes in NMB 5262a (4), NMB 5262e (11).
- elata*, *Helix comboides* [var.], S. Moricand, 1846: 155. No type locality. (Streptaxidae). – Remarks. No type material of this taxon found during our study.
- equestrata*, *Helix*, J. Moricand, 1858: 449, pl. 13 fig. 1. Type locality: [Peru] Moyobamba. Syntypes: MHNG-INVE-72607 (2) (Pleurodontidae) [Figs 69–72]. – Remarks. This material originated from M. Porte, and arrived via Moricand junior in the Brot collection. There is a second lot, MHNG-INVE-72606, which despite a label written in J. Moricand’s hand is doubtful to belong to the original series, and is herein not considered as type material.
- fidaensis*, *Bulimus*, J. Moricand, 1858: 451, pl. 14 fig. 1. Type locality: [Brazil] Bahia. Syntypes: MHNG-INVE-63455 (1) (Bulimulidae) [B: figs 23–24].
- franciscana*, *Unio* (*Monocondylea*), S. Moricand, 1838: 145, pl. 3 figs 14–17. Type locality: [Brazil, Bahia] le fleuve S. Francisco [Blanchet]. Holotype: MHNG-INVE-91235 (1) (Unionidae) [Figs 20–23].
- Remarks. Moricand senior wrote “je n’en ai reçu qu’un seul individu”, thus the pair of shells found is the holotype. One valve in the USNM collection (USNM 86333), although with a label written by Moricand senior, appears to have been sent at a later date, originating from a further shipment that Moricand received from Blanchet; this material is thus not considered as type material.
- haematostoma*, *Helicina*, S. Moricand, 1838: 142, pl. 3 figs 6–7. Type locality: [Brazil] la province de Bahia [Blanchet]. Syntypes: MHNG-INVE-91253 (2) (Helicinidae) [Figs 28–31]. – Remarks. These specimens were found in the Brot collection, but originate from the Moricands. Four ‘Paratypen’ [syntypes] are in NMB 3842a.
- heterogramma*, *Helix* (*Cochlogena*), S. Moricand, 1836b: 437, pl. 2 figs 15–17. Type locality: [Brazil, Bahia] Caxoeira [Blanchet]. Syntypes: MHNG-INVE-64598 (4) (Bulimulidae) [B: figs 84–85].
- heterotricha*, *Helix* (*Cochlogena*), S. Moricand, 1836b: 430, pl. 2 figs 5–6. Type locality: not given (“M. Blanchet ne m’indique pas où il l’a trouvée; mais vraisemblablement elle habite les grands bois” [Brazil, Bahia]). Syntypes: MHNG-INVE-64602 (6) (Simpulopsidae) [B: fig. 26]. – Remarks. Four additional syntypes in NMB 4929b.
- illheocola*, *Helix* (*Cochlogena*) *rhodospira* [var. γ], S. Moricand, 1836b: 428. Type locality: [Brazil, Bahia] Illheos [Blanchet]. Syntypes: MHNG-INVE-60171 (6), MHNG-INVE-60169 (2) (Bulimulidae) [B: fig. 89]. – Remarks. Additional material is in NMB 4924a (4), as ‘Paratypen’ [syntypes].
- immaculata*, *Helix* (*Helicigona*) *pyramidella* [var. α], Moricand, 1836b: 419. – Remarks. Not available name (infrasubspecific).
- leucostoma*, *Helix* (*Cochlogena*) *pudica* [var. α], S. Moricand, 1836b: 438. No type locality given. (Strophocheilidae). – Remarks. No material was found that could be unambiguously attributed as type material. Lot MHNG-INVE-65479 has a label “peristomate albo”; another label in Mermoud’s hand reveals that 11 specimens have been sent to Bequaert in 1947. In his revision of this group Bequaert considered this variety as a synonym of the nominate taxon (Bequaert, 1948: 19, 29).
- leucostoma*, *Melanopsis crenocarina* [var. β], S. Moricand, 1841a: 62. Type locality: [Brazil] Rio de Pedra Branca, province de Bahia [Blanchet]. Syntypes: MHNG-INVE-91241 (2) (Thiaridae) [Fig. 9].
- longiseta*, *Helix* (*Bulimus*), S. Moricand, 1846: 156, pl. 5 fig. 18–20. Type locality: [Brazil] la province de Bahia [Blanchet]. Syntypes: MHNG-INVE-64605 (7) (Bulimulidae) [B: figs 86–87].
- macapa*, *Melania*, J. Moricand, 1856: 176, pl. 6 fig. 7. Type locality: Pérou, Macapa. Paratypes: MHNG-INVE-91239 (3) (Pleuroceridae) [Fig. 12]. – Remarks. According to Fischer-Piette (1950: 16) the

- holotype is in MHNH; it is figured in Simone (2006: fig. 169).
- major dentata*, *Helix* (*Cochlodina*) *pantagruelina* [var. α], S. Moricand, 1836b: 441. – Remarks. Not an available name (this combination of words does not fulfil the requirements of Art. 11.9.5 ICZN Code, because they are a descriptive phrase not based on the name of a single entity).
- major edentula*, *Helix* (*Cochlodina*) *pantagruelina* [var. β], S. Moricand, 1836b: 441. – Remarks. Not an available name (see above).
- manoelii*, *Helix* (*Cochlogena*), S. Moricand, 1841a: 59, pl. 4 figs 4-5. Type locality: [Brazil] la province de Bahia [Blanchet]. Syntypes: MHNG-INVE-64551 (8), MHNG-INVE-91244 (12) (Bulimulidae) [B: fig. 25]. – Etymology. Named after the ‘gaucho’ Manoel, one of the assistants of J.S. Blanchet.
- mariae*, *Bulimus*, J. Moricand, 1858: 453, pl. 14 fig. 5. Type locality: [Peru] Tarapoto. Syntypes: MHNG-INVE-64389 (7) (Bulimulidae) [B: figs 47-48].
- melanostoma*, *Helix* (*Cochlogena*) *maximiliana* [var. β], S. Moricand, 1836b: 431. Type locality: [Brazil, Bahia] Illheos [Blanchet]. (Bulimulidae). – Remarks. No material was found that unambiguously can be attributed as type material. Two syntypes labeled as this variety in NMB 1376c.
- melanostoma*, *Melanopsis* *crenocarina* [var. α], S. Moricand, 1841a: 62. Type locality: [Brazil] Rio de Pedra Branca, province de Bahia [Blanchet]. Syntypes: MHNG-INVE-91242 (3) (Thiaridae) [Fig. 7].
- minor*, *Helix* (*Cochlogena*) *maximiliana* [var. γ], S. Moricand, 1836b: 431. Type locality: [Brazil, Bahia] Illheos [Blanchet]. Syntypes: MHNG-INVE-60152 (11) (Bulimulidae) [B: fig. 90]. – Remarks. Additional material as syntypes NMB 8510a (3).
- minor*, *Helix* (*Cochlodina*) *pantagruelina* [var. γ], S. Moricand, 1836b: 441. No type locality [Blanchet]. Syntypes: MHNG-INVE-64698 (3) (Odontostomidae) [B: fig. 124].
- moyobambensis*, *Helix*, J. Moricand, 1858: 450, pl. 13 fig. 3. Type locality: [Peru] Moyobamba. Syntypes: MHNG-INVE-68036 (1), MHNG-INVE-68666 (1) (Haplotrematidae) [Figs 77-79]. – Remarks. Moricand junior did not mention on how many specimens his description was based. Lot 68036 appears to have been collected by M. Porte and was part of the Moricand collection. Lot 68666 was part of the Brot collection, but originates from Moricand junior, and is here considered as belonging to the original series.
- nigrescens*, *Helix* (*Cochlogena*) *coxeiranus* [var. γ], S. Moricand, 1836b: 433, pl. 2 fig. 9. Type locality: [Brazil] Caxoeira, dans la province de Bahia, et dans les bois de St.-Gonsalves [Blanchet]. – Remarks. Not available name (infrasubspecific).
- obeliscus*, *Helix* (*Cochlicella*), S. Moricand, 1834b: 540, pl. 1 fig. 4. Type locality: Brésil, près de Caravelhas [Blanchet]. Holotype: MHNG-INVE-66256 (1) (Subulinidae) [Fig. 68]. – Remarks. In the original paper Moricand stated “je n’en connais qu’un seul individu”. The lot found consists of nine specimens, but seems to be a mixture of specimens obtained at different times, as Moricand (1836b: 424) wrote “L’individu que j’ai figuré [in Moricand, 1834b] n’était pas adulte, j’en ai reçu depuis lors qui ont 16 tours de spire, et un autre plus grand encore”. The specimen closely matching the original dimensions has been figured and is considered the holotype.
- pantagruelina*, *Helix* (*Cochlodina*), S. Moricand, 1834b: 542, pl. 1 fig. 7. Type locality: le Brésil [Blanchet]. Syntypes: MHNG-INVE-64695 (1 + 14) (Odontostomidae) [B: fig. 123]. – Remarks. Additional syntypes are NMB 4934a (4), NMB 4934b (1).
- pileiformis*, *Helix* (*Helicodonta*), S. Moricand, 1836b: 420, pl. 2 fig. 2. Type locality: [Brazil] Illheos [Blanchet]. Neotype: MHNG-INVE-64567 (1) (Simpulopsidae) [B: figs 40-41]. – Remarks. Additional material is listed as syntypes in NMB 1482a (3), NMB 1482a’ (2).
- pleurophora*, *Helix*, S. Moricand, 1846: 150, pl. 5 figs 6-9. Type locality: [Brazil] la province de Bahia [Blanchet]. Syntypes: MHNG-INVE-69077 (18) (Charopidae) [Figs 86-88].
- polygramma*, *Helix* (*Cochlogena*), S. Moricand 1836b: 436, pl. 2 figs 12-14. Type locality: [Brazil, Bahia] Caxoeira [Blanchet]. Syntypes: MHNG-INVE-64561 (4) (Bulimulidae) [B: figs 136-137]. – Remarks. Additional material in NMB 1478a (3) as ‘Paratypen’ [syntypes].
- pseudopiperatus*, *Bulimus*, J. Moricand, 1858: 451, pl. 14 fig. 2. Type locality: [Peru] Moyobamba. Syntypes: MHNG-INVE-55493 (1) (Amphibulimidae) [B: figs 1-3].
- pseudosuccinea*, *Helix* (*Cochlogena*), S. Moricand, 1836b: 435, pl. 2 fig. 18. Type locality: [Brazil] aux environs de Bahia [Blanchet]. Syntypes: MHNG-INVE-64619 (2 + 7) (Simpulopsidae) [B: fig. 11]. – Remarks. Other syntypes in NMB 1413a (8), NMB 1413b (19).
- pubescens*, *Helix* (*Bulimus*), S. Moricand, 1846: 157, pl. 5 figs 21-25. Type locality: [Brazil] les environs de Bahia [Blanchet]. Syntypes: MHNG-INVE-64606 (68) (Simpulopsidae) [B: fig. 27]. – Remarks. Additional syntypes in NMB 1429a (2), NMB 1429b (11).
- purpurascens*, *Helix* (*Cochlogena*) *coxeiranus* [var. δ], S. Moricand, 1836b: 433, pl. 2 fig. 10. Type locality: [Brazil] Caxoeira, dans la province de Bahia, et dans les bois de St.-Gonsalves [Blanchet]. – Remarks. Not available name (infrasubspecific).
- reticulata*, *Unio* (*Monocondylea*), J. Moricand, 1858: 454, pl. 15 fig. 2. Type locality: Amazone. Syntypes: MHNG-INVE-91236 (2) (Unionidae) [Figs 37-40]. –

The specimens were accompanied by a label stating “Revised Haas 1930”.

rhodospira, *Helix* (*Cochlogena*), S. Moricand, 1836b: 428. New name for *Helix melanostoma* Férussac, 1821 not Draparnaud, 1801. (Bulimulidae). – Remarks. Currently considered as a junior subjective synonym of *Auris melanostoma* Spix, 1827.

rhodostoma, *Helix* (*Cochlogena*) *pudica* [var. β], S. Moricand, 1836b: 438. No type locality given. (Strophocheilidae). – Remarks. No material was found that could be unambiguously attributed as type material. According to Bequaert (1948: 35) five specimens were sent by Mermod that are considered ‘cotypes’ (now MCZ 475520). NMB 8045a contains two specimens listed as syntypes.

rosea, *Helix* (*Helicigona*) *pyramidella* [var. β], S. Moricand, 1836b: 419. – Remarks. Not available name (infrasubspecific).

rosea immaculata, *Helix* (*Helicigona*) *pyramidella* [var. α], S. Moricand, 1836b: 419. – Remarks. Not an available name (this combination of words does not fulfil the requirements of Art. 11.9.5 ICZN Code, because they are a descriptive phrase not based on the name of a single entity, and the name has not been used as valid before 1985).

rufovirens, *Helix* (*Succinea*), S. Moricand, 1846: 147, pl. 5 fig. 4. Type locality: le Brésil, dans la province de Bahia [Blanchet]. Syntypes: MHNG-INVE-64632 (50+), MHNG-INVE-78493 (13) (Simpulopsidae) [B: figs 12-14].

semenlini, *Helix*, S. Moricand, 1846: 149, pl. 5 fig. 17. Type locality: [Brazil] les environs de Bahia [Blanchet]. Syntypes: MHNG-INVE-70933 (7) (Euconulidae) [Figs 83-85]. – Remarks. There are five additional specimens separated in tubes without labels, of which it is unclear if they belong to the original series or not. Additional syntypes in NMB 7517a (2).

similaris, *Bulimus*, J. Moricand, 1856: 177, pl. 6 fig. 8. Type locality: [Peru] Moyobamba. Syntypes: MHNG-INVE-63531 (7) (Bulimulidae) [B: fig. 51].

spixiana, *Helix* (*Helicigona*) *pyramidella* [var. ζ], Moricand, 1836b: 419. – Remarks. Not available name (infrasubspecific).

stefanensis, *Etheria*, J. Moricand, 1856: 178, pl. 7 fig. 10. Type locality: Haut Amazone. Syntypes: MHNG-INVE-91237 (1) (Unionidae) [Figs 54-57]. – Etymology. Named after Stéfano Moricand.

streptodon, *Helix* (*Streptaxis*), S. Moricand, 1851: 369, pl. 10 figs 1a-c. Type locality: La province de Bahia (Brésil). Syntypes: MHNG-INVE-68696 (1) (Streptaxidae) [Figs 64-66].

subuliformis, *Helix* (*Cochlicella*), S. Moricand, 1836b: 427, pl. 2 fig. 3. Type locality: [Brazil] St. Gonsalves, non loin de Bahia [Blanchet]. Probable syntypes: MHNG-INVE-66259 (7) (Subulinidae) [Fig. 67]. – Remarks. The material is labelled “Bahia” in J.

Moricand’s hand, but none of the specimens are exactly matching the original dimensions; the material is considered as probable syntypes. Four additional specimens are listed as ‘Syntypen’ in NMB 7649a.

tarapotonensis, *Helix*, J. Moricand, 1858: 450, pl. 13 fig. 2. Type locality: [Peru] Tarapoto. Syntype: MHNG-INVE-72711 (1) (Pleurodontidae) [Figs 73-76]. – Remarks. Moricand junior did not state on how many specimens his description was based.

texasiana, *Helix* (*Helicodonta*), S. Moricand, 1834b: 538, pl. 1 fig. 2. Type locality: le Mexique, dans la province de Texas [Berlandier]. Syntypes: MHNG-INVE-72781 (7), MHNG-INVE-72867 (32) (Polygyridae) [Figs 44-46]. – Remarks. Both lots are with labels by Moricand junior, the second lot was part of the Brot collection. Additional syntypes in NMB 1517c (9).

tomigera, *Helix* (*Cochlodonta*), S. Moricand, 1836b: 439; S. Moricand, 1841: pl. 5 figs 13-15. Type locality: [Brazil, Bahia] Caxoeira [Blanchet]. Syntype: MHNG-INVE-64717 (1) (Odontostomidae) [B: figs 115-117].

tomigeroides, *Helix*, S. Moricand, 1846: 153, pl. 5 figs 10-12. Type locality: [Brazil] la province de Bahia [Blanchet]. Syntypes: MHNG-INVE-64718 (16) (Odontostomidae) [B: figs 118-121]. – Remarks. More material in NMB 1491b (5), as syntypes.

trizona, *Helix* (*Cochlogena*) *coxeiranus* [var. α], S. Moricand, 1836b: 434, pl. 2 fig. 7. Type locality: [Brazil] Caxoeira, dans la province de Bahia, et dans les bois de St.-Gonsalves [Blanchet]. – Remarks. Not an available name (infrasubspecific).

unicolor, *Helix* (*Cochlogena*) *coxeiranus* [var. ϵ], S. Moricand, 1836b: 434. Type locality: [Brazil] Caxoeira, dans la province de Bahia, et dans les bois de St.-Gonsalves [Blanchet]. – Remarks. Not an available name (infrasubspecific).

unicolor, *Helix* (*Cochlogena*) *vittata* [var. γ], S. Moricand, 1836b: 433. Type locality: [Brazil, Bahia] les forêts de Illheos [Blanchet]. (Simpulopsidae). – Remarks. Material of this taxon has not been found during this study. Seven specimens are listed as syntypes in NMB 1420d.

velutohispida, *Helix* (*Cochlogena*), S. Moricand, 1836b: 429, pl. 2 fig. 4. No type locality [Blanchet]. Syntypes: MHNG-INVE-64611 (5 + 2) (Simpulopsidae) [B: fig. 28]. – Remarks. In NMB additional type material is present; NMB 1477a (1), NMB 1477b (1), listed as ‘Paratypen’ [syntypes] and syntypes respectively.

ventricosa, *Vibex*, J. Moricand, 1856: 175, pl. 6 fig. 6. Type locality: Pérou, Macapa. Syntypes: MHNG-INVE-91243 (3) (Pleuroceridae) [Fig. 10].

versicolor, *Helix* (*Helicigona*) *pyramidella* [var. γ], S. Moricand, 1836b: 419. – Remarks. Not available name (infrasubspecific).

viminea, *Helix* (*Cochlogena*), S. Moricand, 1834b: 540, pl. 1 fig. 5. Type locality: le Brésil, aux environs de Bahia [Blanchet]. Syntypes: MHNG-INVE-64563

- (9) (Simpulopsidae) [B: fig. 22]. – Remarks. More syntypes in NMB 1480a (6), NMB 1480b (9).
- vittatozonata*, *Helix* (*Cochlogena*) *vittata* [var. β], S. Moricand, 1836b: 433. Type locality: [Brazil, Bahia] les forêts de Illheos [Blanchet]. (Simpulopsidae). – Remarks. Material of this taxon has not been found during this study.
- vittato zonata*, *Helix* (*Cochlogena*) *vittata* [var. α], S. Moricand, 1836b: 432. – Remarks. Not an available name (this combination of words does not fulfil the requirements of Art. 11.9.5 ICZN Code, because they are a descriptive phrase not based on the name of a single entity, and the name has not been used as valid before 1985).
- vulgaris*, *Helix* (*Cochlogena*) *rhodospira* [var. α], S. Moricand, 1836b: 428. Type locality: [Brazil] aux environs de Bahia [Blanchet]. Syntypes: MHNG-INVE-60163 (4) (Bulimulidae). – Remarks. Additional type material in NMB 1377a (9), as syntypes.
- zonata*, *Helix* (*Cochlodina*) *exesa* var., S. Moricand, 1841a: 61, pl. 4 figs 8-9. No type locality [Blanchet]. (Odontostomidae). – No material has been found during this study that can be attributed as type material.

EPONYMS

The following taxa were named after Moricand senior or junior. Eponyms for animals have been extracted from Sherborn (2006), Ruhoff (1980), Neave (2015), and the Index to Organism Names (ION, 2015); plant eponyms have been extracted from the International Plant Names Index (IPNI, 2014). Their systematic position is given in parenthesis; for eponyms in animals also the phylum is given. The current classification at family level is given between brackets.

- Amphiscopia moricandiana* Nees in A.P. de Candolle, 1847: 357 (Plantae, Acanthaceae).
- Ancylus moricandi* d'Orbigny, 1837 [1834-1847]: 355 (Mollusca, Ancyliidae).
- Anodonta moricandi* Lea, 1860: 90 (Mollusca, Unionidae).
- Brassica moricandia* Boissier, 1839: 34. Nomen illegitimum (IPNI, 2014) (Plantae, Brassicaceae).
- Brassica moricandioides* Boissier, 1838: 10 (Plantae, Brassicaceae).
- Bulimus moricandi* L. Pfeiffer, 1847: 113 (Mollusca, Bulimulidae).
- Cleome moricandii* Briquet, 1914: 376 (Plantae, Capparaceae).
- Convolvulus moricandii* Kuntze, 1898: 214 (Plantae, Convolvulaceae).
- Cyclostoma moricandi* L. Pfeiffer, 1852: 64. New name for *Cyclostoma disjunctum* S. Moricand, 1846 not Matheron, 1832 (Mollusca, Epitoniidae).
- Dalea moricandii* Dietrich, 1847: 1015 (Plantae, Leguminosae).
- Diguetia moricandinana* Martius 1841 [in Martius & Eichler 1841-1872]: 22 (Plantae, Annonaceae).
- Dipladenia moricandiana* A.P. de Candolle, 1844: 486 (Plantae, Apocynaceae).
- Etheria stefanensis* J. Moricand, 1856: 178, pl. 7 fig. 10 (Mollusca, Etheridae).
- Eunomia moricandiana* Boissier, 1844: 83 (Plantae, Brassicaceae).
- Gephyrraulus moricandiae* Sylven & Solinas, 1987: 27. (Diptera, Cecidomyiidae).
- Granaria moricandi* "Férussac" F. Held, 1837: 918. Nomen nudum (Mollusca).
- Haemulon moricandi* Ranzani, 1842: 345, pl. 31 fig. 1 (Pisees, Haemulidae).
- Helix moricandi* G.B. Sowerby II in L. Pfeiffer, 1842: 34 (Mollusca, Bradybaenidae).
- Helix moricandi* A.E. Férussac, 1821 [1821-1822]: 64. Nomen nudum (Mollusca).
- Hiraea moricandiana* Jussieu, 1840: 259 (Plantae, Malpighiaceae).
- Hyperbaena moricandii* Miers, 1851: 44 (Plantae, Menispermaceae).
- Melania moricandi* Brot, 1868: 22 (Mollusca, Thiariidae).
- Moricandia* A.P. de Candolle, 1821: 75 (Plantae, Brassicaceae).
- Moricandia* Pilsbry & Vanatta in Pilsbry 1898: 57 (Mollusca, Odontostomidae).
- Planorbis moricandi* Beck 1837: 120. Nomen nudum (Mollusca).
- Plectrochoerus moricandi* Pictet, 1843b: 227 (Mammalia, Erethizontidae).
- Polypodium moricandii* Mettenius, 1856: 87, pl. 1 figs 47-48 (Plantae, Polypodiaceae).
- Psylliodes peyerimhoffi moricandiae* Peyerimhoff, 1925: 15 (Arthropoda, Chrysomelidae).
- Rhytiglossa moricandiana* Nees in A.P. de Candolle, 1847: 341 (Plantae, Acanthaceae).
- Rytidocarpus moricandioides* Cosson, 1888 [1882-1890]: 100, pl. 64b (Plantae, Brassicaceae).
- Solanum moricandi* Dunal in A.P. de Candolle, 1852: 319 (Plantae, Solanaceae).
- Solaropsis moricandi* Beck 1837: 27 (Mollusca, Solaropsidae).
- Stoastoma moricandianum* C.B. Adams, 1851: 150 (Mollusca, Stoastomatidae).
- Succinea moricandi* L. Pfeiffer, 1842: 131 (Mollusca, Simpulopsidae).
- Thibaudia moricandii* Dunal in A.P. de Candolle, 1839: 563 (Plantae, Ericaceae).

NOTES ON THE COLLECTION

The Moricand collection

Around 1850, Moricand senior and junior decided to make an inventory of their collection (Figs 4-5). They listed all molluscan species alphabetically per genus. Starting with the land and freshwater species, they had listed 1567 species by September 1850, and 4200 (including Bivalvia) by the end of October 1859. According to a note in pencil, likely in a different handwriting, another 1750 taxa were added, bringing the grand total for this category up to 5950 (Fig. 6). A second book was made for the marine species, with 929 names listed per ultimo 1855, and 1752 taxa listed four years later. These lists give only a partial overview of the extent of their collection, because many species were represented by more than one lot. When

looking to the listings it becomes clear that the text is in the hand of Moricand junior. Furthermore it is evident that these lists are relatively poor in information content, i.e. they present only taxon names, neither numbers of specimens or lots, nor provenance data are provided. Since all original labels seem to have been destroyed, the scientific value of the collection is not optimal but still considerable (see also Breure, 2016). The handwritings of father and son Moricand are similar, yet distinct upon close inspection. The handwriting of senior is more rounded, while that of junior is less regular. To facilitate recognition, the labels of each of them have been largely grouped together in a version of this paper available at DOI: 10.13140/RG.2.1.3573.0649 [S. Moricand: figs 7-26, 39-40, J. Moricand: figs 27-35, interspersed with some of Brot (see below). Close



Figs 4-6. Inventories of the Moricand collection. (4) Titles of front covers in both books. (5) Part of text dealing with terrestrial mollusc species. (6) First page of 'Coquilles terrestres et fluviales', showing progress through time.

cooperation between Moricand senior and junior is evidenced by a label written by S. Moricand of a taxon described by J. Moricand (Fig. 15) and vice versa (Fig. 27)]. The recognition of handwritings can greatly facilitate the discovery of links between collections (cf. Albano *et al.*, 2014), trace the origin of material, and allow the recognition of type material (Breure & Ablett, 2011).

Ritter (1855: vii) stated that after the death of Moricand senior the whole collection, including about 50,000 plants, stayed in the possession of the family; this was also the case when Moricand junior died in 1877. Alphonse de Candolle (1880: 435) mentioned in his alphabetical list of plant herbaria serving as reference for botanical studies under [S.] Moricand “Chez son fils, le Dr Morieand [probably his youngest son Alexandre (1827-1890), who was medical doctor], à Genève”; it may be safely assumed the total collection remained intact till the next generation decided to waive the collection.

When the last child of Moricand senior, his daughter Delphine, died in 1907, the family had to decide on the fate of the considerable collection. His grand-son Philippe Moricand (1859-1928), living in Paris, decided in 1908 to donate the whole collection to the Muséum d'histoire naturelle (shells and butterflies, *teste* Anonymous, 1909: 135; Anonymous, 1910: 132) and the Conservatoire botanique de la Ville de Genève (plants, archives). The official transfer of the whole collection to the two new depositories was made on 14 August 1908 (Briquet, 1911: 6).

Auguste Brot and his collection

Closely linked to the Morieand collection was a contemporary Genevan conchologist, August Louis Brot (18 September 1821, Gênes - 30 August 1896, Geneva; Fig. 3). Entries on education show him graduating at the university in 1840, continuing his medical studies in Zurich, Paris and Berlin, where he obtained his doctorate in 1845 with the thesis *De anaesthesia nervi quinti*. From 1845-1848 he practised medicine in Geneva, after which he dedicated himself totally to natural history, especially malacology. He was a specialist in the freshwater family Thiaridae and during more than forty years he served on the ‘commission directrice du Musée d'histoire naturelle’ (Bedot, 1896; Candolle, 1897: lx-lxi; Stelling-Michaud, 1966: 344). His considerable private collection was given to the museum after his death, the inventory of which

was made by the paleontologist P. de Lorient (present in MHNG archive). Working with part of his collection (Breure, 2016), it became clear that there must have been close links between Brot and (likely) Moricand junior; type material of several Moricand taxa are present in the Brot collection and vice versa.

In his spare time he played violoncello and was also actively engaged with the local Conservatorium (Campos, 2013).

Contacts with other malacologists and dealers

Neither Moricand senior, nor junior, nor Brot are known to have travelled outside Europe, and their mollusc collections were presumably assembled by gifts, exchange or purchase. Based on information found on labels during the study performed by Breure (2016), from literature and limited database searches, the following preliminary list has been compiled. Note that not all names could be deciphered or traced. This list is currently limited and mainly based on Neotropical material. Abbreviations: B, Brot; JM, Moricand junior; M, Moricand senior or junior; SM, Moricand senior.

Adams C.B. (1814-1853) [SM]: A clipping from a cover of a publication, with a dedication to Moricand senior, is in the handwriting archive at MHNG.

Albers J.C. (1795-1857) [JM]: Several lots have been found with a label in J. Moricand's hand that mentions Albers as the source of the material. However, it cannot be excluded that the link was actually established via Moricand senior as junior may have curated their collection during his later years.

Anthony J.G. (1804-1877) [SM]: Some lots were found, possibly this was material received in exchange.

Benoit L. (1804-1890) [M]: Some European material originating from him in the Moricand collection.

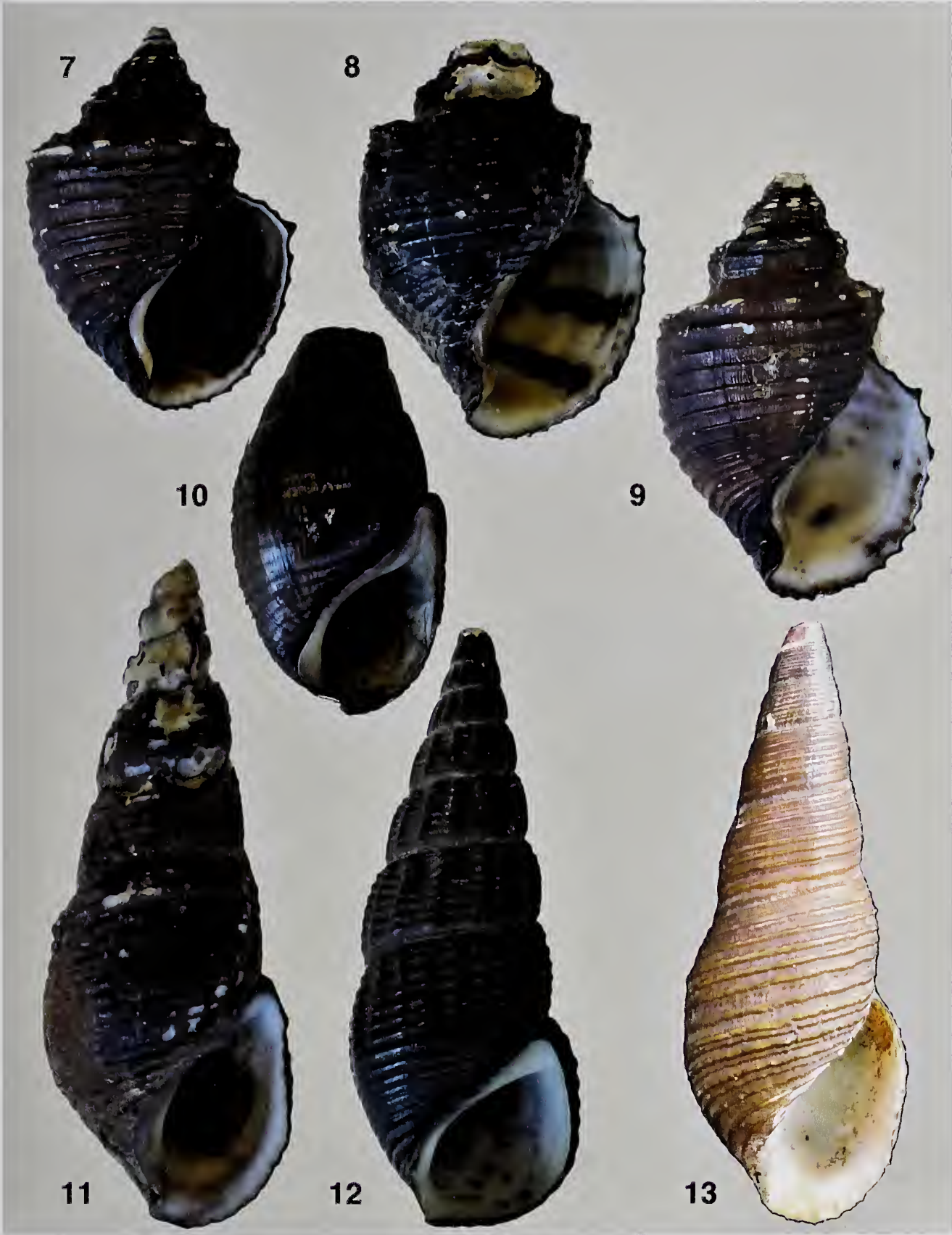
Berlandier J.L. (1805-1851) [SM]: Collected for Moricand senior in Mexico and U.S.A.

Bernardi A.C. (?-1863) [SM]: Some material from northern South America.

Blanchet J.S. (1807-1875) [SM]: Besides being an important source of Brazilian material, as mentioned before, some labels have been found where Blanchet is linked to Peruvian material. It is not known, however, if Blanchet travelled himself to Peru, or traded in material collected by others.

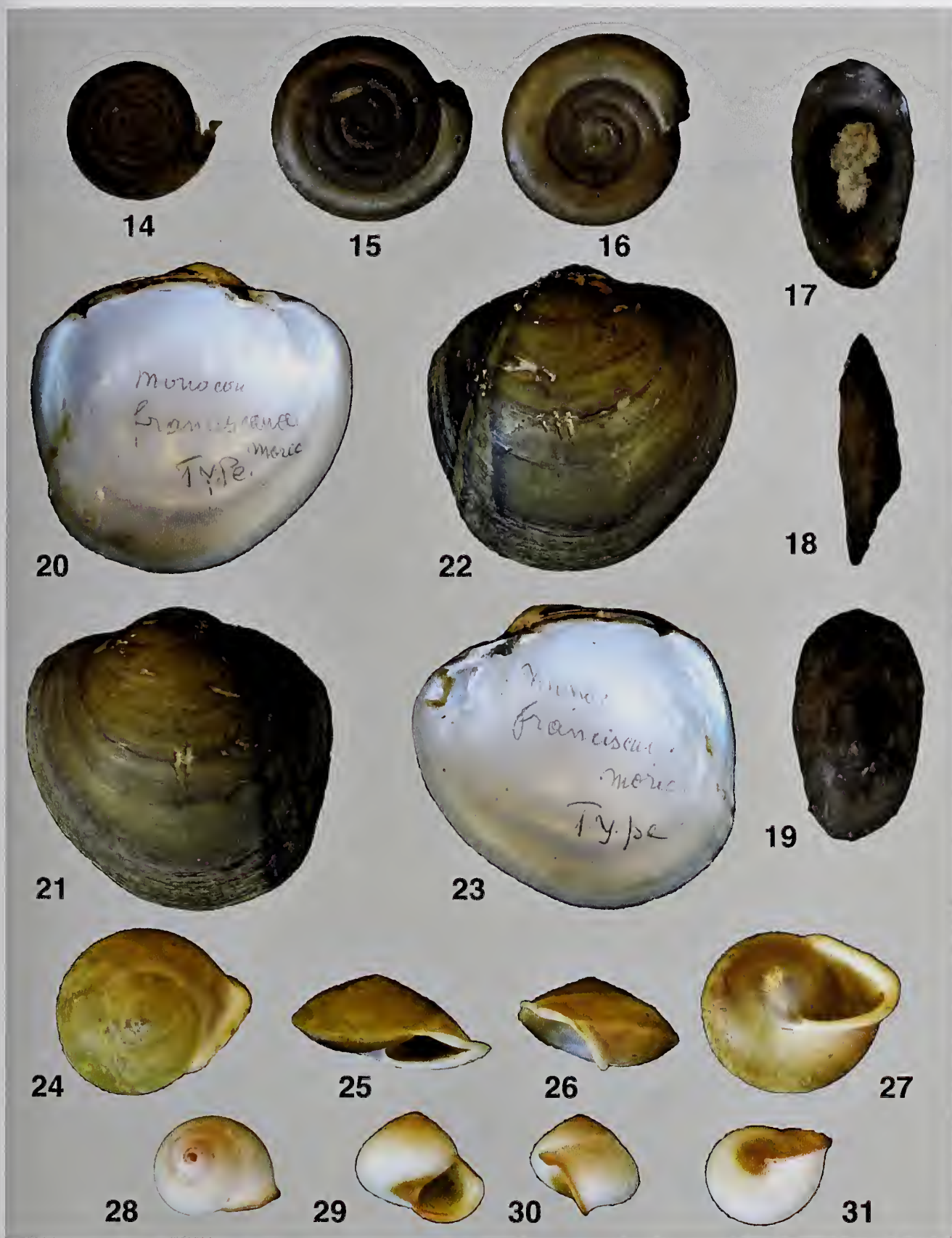
Blauner B.F. (1803-1853) [SM]: Some material that may be associated to Shuttleworth probably reached the

Figs 7-13. Thiaridae and Pleuroceridae. (7-9) Thiaridae. (7-9) *Aylacostoma crenocarina* (S. Moricand, 1841), (7) syntype of *Melanopsis crenocarina melanostoma* S. Moricand, 1841, MHNG-INVE-91242 (H = 38.8), (8) syntype of *Melanopsis crenocarina bilineata* S. Moricand, 1841, MHNG-INVE-91240 (H = 36.2), (9) syntype of *Melanopsis crenocarina leucostoma* S. Moricand, 1841, MHNG-INVE-91241 (H = 42.9). (10-13) Pleuroceridae. (10) *Doryssa ventricosa* (J. Moricand, 1856), syntype, MHNG-INVE-91243 (H = 37.6). (11) *Doryssa brasiliensis* (S. Moricand, 1838), syntype, MHNG-INVE-91238 (H = 41.1). (12) *Doryssa macapa* (J. Moricand, 1856), syntype, MHNG-INVE-91239 (H = 37.1). (13) *Doryssa cingulata* (J. Moricand, 1860), syntype, MHNG-INVE-91245 (H = 33.5). ▶



- Moricands via Blauner (who wrote "Mon cher ami Mr. Shuttleworth...", letter 18 August 1848; see also under Shuttleworth).
- Boissier P.E. (1810-1885) [SM]: Some type material of species described by Charpentier and Pfeiffer is in the collection originating from Boissier.
- Bourguignat J.R. (1829-1892) [M]: Few lots in the collection.
- Broeck J.E. van den (1851-1932) [B]: Some material from the West Indies.
- Bronn H.G. (1800-1862) [SM]: Exchanged material with Moricand senior (Neubert & Janssen, 2004).
- Charpentier J.G.F. de (1786-1855) [SM]: A letter, dated 15 November 1852, addressed to Moricand senior is in the handwriting archive.
- Coronado F. (?-1881) [B]: Material from West Indies.
- Cristofori G.J. de (1803-1837) [SM]: Some Mediterranean material.
- Cuming H. (1791-1865) [SM]: There are quite a number of lots in the Moricand collection of which the provenance is linked to Cuming. However, it is not clear whether (likely) Moricand (senior) received these directly from Cuming, or via J.E. Gray (see below). Another important, unresolved, question is during which year these specimens reached Geneva (see Breure, 2016), as this may be decisive for the possible type status.
- Damon R. (1814-1889) [B]: Some material supplied by him from various regions of the Americas, Australia, and the Pacific has been found.
- Dautzenberg P. (1849-1935) [B]: Few material originating from him is present in the collection.
- Dohrn H. (1838-1913) [B]: Few lots from northern South America are present.
- Férussac A.E.J.P.F. d'Audebard de (1786-1836) [SM]: Although there are but a few shells found of which the provenance directly links to Férussac, this was apparently a good contact of Moricand senior as in his early papers he frequently refers to his opinion. Férussac also named two new molluscs after Moricand (see Eponyms).
- Fischer P.H. (1835-1893) [B]: A clipping from an envelope addressed to Brot is present in the handwriting archive.
- Fulton H.C. (1861-1942) [B]: Few material, some with original labels retained.
- Gassies J.B. (1816-1883) [B]: A clipping with a 'hommage' to Brot is in the handwriting archive.
- Geale R.F. (18**-?) [B]: Some material supplied by him from various regions of the Americas, and Pacific islands has been found.
- Gray J.E. (1800-1875) [SM?]: There is a small clipping in the handwriting archive that is attributed to Gray and mentions Cuming's name. It is not known to precisely whom this letter was addressed to; see sub Cuming.
- Haines W.A. (?-?) [M]: Some material originating from him, possibly in exchange.
- Hyde W. (?-?) [SM]: Some labels of American Unionidae bear the printed inscription "from / William Hyde, / No. 77 Chesnut Street, / Philadelphia".
- Jan G. (1791-1866) [SM]: Some type material of De Cristofori & Jan, originating from the latter.
- Jay J.C. (1808-1891) [SM?]: Some material originating from him, which may have reached Moricand (senior?) via J.E. Gray.
- Jeanneret ? (?-1869) [SM]: Some material from West Indies.
- Landauer M.J. (18**-?) [B]: Quite a number of lots, especially from various parts of South America, Mexico and West Indies, and from the Pacific islands.
- Lea I. (1792-1886) [SM]: Material of American Unionidae gives Lea's name as source.
- Marie E.A. (1835-1888) [B]: Few material from Pacific and Caribbean islands.
- Martens E. von (1831-1904) [B]: Correspondence present in handwriting archive.
- Menke K.T. (1791-1861) [SM]: One lot originating from him present, which may have arrived indirectly.
- Mörch O.A.L. (1828-1878) [M/B]: Few lots with material from West Indies and Chile. Not clear if the contact was with Moricand senior or junior.
- Morelet P.M.A. (1809-1892) [SM]: Some material from Mexico and Central America was found, including type material.
- Mortillet L.L.G. de (1821-1898) [B]: A letter dated 6 January 1866 is in the handwriting archive.
- Mousson J.R.A. (1805-1890) [JM?/B?]: A type lot of a clausiliid species described by Mousson in 1859.
- Newcomb W. (1818-1892) [M?/B?]: Few material originating from Newcomb.
- d'Orbigny A. (1802-1857) [SM]: Important source of non-Brazilian material, including type material of a number of species described by d'Orbigny. Other parts of his collection are present in Paris and London. Dedicated one new freshwater species to Moricand (see Eponyms).

Figs 14-31. Planorbidae, Unionidae, and Helicinidae. (48-53) Planorbidae. (14) *Drepanotrema cimex* (S. Moricand, 1838), syntype, MHNG-INVE-86802 (D = 6.03). (15-16) *Drepanotrema depressissimus* (S. Moricand, syntype, MHNG-INVE-86940 (D = 8.99). (17-19) *Uncancylus concentricus* (d'Orbigny, 1835), syntype of *Ancylus barilensis* S. Moricand, 1846, MHNG-INVE-87402 (D = 7.49). (20-23) Unionidae. (20-23) *Monocondylaea franciscana* (S. Moricand, 1838), holotype, MHNG-INVE-91235 (D = 39.5). (24-31) Helicinidae. (24-27) *Helicina caracolla* (S. Moricand, 1836), syntype, MHNG-INVE-91246 (D = 15.2). (28-31) *Helicina haematostoma* (S. Moricand, 1838), syntype, MHNG-INVE-91253 (D = 8.75).



- Paladilhe J.L.I.A. de (1814-1876) [SM/JM]: Two clippings from envelops mentioning Moricand's name are in the handwriting archive. It is not clear whether they were addressed to senior or junior.
- Parreyss L.J.M. (1799-1879) [B]: Quite some material from various regions of the Americas, and Pacific islands has been found.
- Petit de la Saussaye S.A.A. (1792-1870) [SM]: Several lots in the Moricand collection, among which type material of Petit taxa. A letter (16 June 1851) is in the handwriting archive.
- Pfeiffer L.C.G.L. (1804-1877) [SM]: Although there is no direct evidence for exchange of material, the two undoubtedly had contact as Pfeiffer dedicated two new taxa to Moricand (see Eponyms).
- Phillips J.S. (18**-?) [SM]: Moricand senior was in contact with this malacologist from Philadelphia, U.S.A.
- Pini N. (?-?) [SM]: Clippings from a postcard are present in the handwriting archive.
- Porte M. (?-1866) [JM]: Sent material from the eastern Andes in Peru, among which several new species.
- Ranzani C. (1775-1841) [SM]: Not a malacologist but director of the Museo di Zoologia dell'Università di Bologna, where freshwater shells are in the collection with labels by Moricand senior (Albano *et al.*, 2014: fig. 2A). Ranzani dedicated a new fish after Moricand (see Eponyms).
- Sallé A. (1829-1896) [JM]: Material was found in the Moricand collection which has been collected by Sallé during his travels to the Caribbean and Central America; likely a contact of Moricand junior.
- Saussure H.L.F. de (1829-1905) [JM]: Some material from Mexico was found; likely a contact of Moricand junior.
- Say T. (1787-1834) [SM]: Some labels mention his name as source of material in the Moricand collection.
- Schepman M.M. (1847-1919) [B]: A clipping from correspondence is in the handwriting archive.
- Schneider G. (18**-?) [B]: Some material from northern South America, and from New Caledonia is present in the collection.
- Semper C.G. (1832-1893) [B]: Some labels from material exchanged with Brot are in the handwriting archive.
- Shuttleworth R.J. (1810-1874) [M/B]: Several lots with material from the West Indies. Letter dated 7 August 1852 in the handwriting archive. In the Shuttleworth collection also specimens received from Moricand senior are present (Neubert & Gosteli, 2003: 32, 54).
- Sowerby G.B. III (1843-1921) [B]: Several lots were found with 'Sowerby' as source, some with material that evidently came from the Cuming collection.
- Stabile G. (1826-1869) [M]: Some Clausiliidae material originating from him.
- Stoll O. (1849-1922) [B]: Several lots from Mexico and Central America.
- Sumichrast A.L.J.F. (1828-1882) [B]: Several lots from Mexico.
- Terver A.P. (1789-1875) [M]: Few lots of European material received from him are in the collection.
- Verreaux J.P. (1807-1873) [JM?/B]: On several labels occurs the name "Verreaux"; it is assumed that this was J.P. Verreaux (see Neubert & Gosteli 2003: 8).
- Villa A. (1806-1885) & Villa G. (1810-1887) [JM?/B]: A clipping from correspondence "à Mons. Moricand" is in the handwriting archive; it is not clear if this was a contact of senior or junior. Furthermore there is a list of freshwater shells (Unionidae) "al Sig. Auguste Brot".
- Vimont A.Z. (?-1883) [B]: Material from different parts of the globe.
- Webb P.B. (1793-1854) [SM]: Some material collected by Webb on the Canary Islands is present.

Of the following authors (supposed) type material is present in the Moricand collection: C.B. Adams, Anthony, Benoit, Bielz, Binney, Bourignat, Brot, Charpentier, de Cristofori & Jan, Deshayes, d'Orbigny, Draparnaud, Férussac, Friwaldsky, Gray, Held, Huet, Jan, Jay, Küster, Martens, Menke, Morelet, Mortillet, Mousson, Pfeiffer, Rossmässler, Say, Shuttleworth, Stabile, Terver, Villa, Wagner, and Webb & Berthelot. As far as material did not come directly from these authors, third persons may have been involved, but the check of provenance of all type material was beyond the scope of our study. Material from the Moricand collection has been found as received in exchange in the registers of the Museum of Comparative Zoology, Cambridge, and the National Museum of Natural History, Smithsonian Institution, Washington D.C, both U.S.A.; however, in both cases no date is mentioned and it is likely these exchanges were made during the course of the 20th century.

Figs 32-49. Ampullariidae, Planorbidae, Unionidae, Polygyridae, and Megalomastomidae. (32-33) Ampullariidae. (32-33) *Pomacea decussata* (S. Moricand, 1836), syntype, MHNG-INVE-33485 (H = 29.4). (34-36) Planorbidae. (34-36) *Biomphalaria glabrata* (Say, 1818), syntype of *Planorbis dentifer* J. Moricand, 1853, MHNG-INVE-86932 (D = 12.7). (37-40) Unionidae. (37-40) *Monocondylaea reticulata* (J. Moricand, 1858), syntype, MHNG-INVE-91236 (D = 41.8). (41-46) Polygyridae. (41-43) *Praticolella (Praticolella) berlandieriana* (S. Moricand, 1834), syntype, MHNG-INVE-37027 (H = 8.98). (44-46) Polygyra (*Linisia*) *texasiana texasiana* (S. Moricand, 1833), syntype, MHNG-INVE-72781 (D = 10.4). (47-49) Megalomastomidae. (47-49) *Aperostoma blanchetiana* (S. Moricand, 1836), syntype, MHNG-INVE-91233 (D = 30.3).



EPILOGUE

Moricand senior and junior have enriched our knowledge of the European and Neotropical flora and fauna with the introduction of many new taxa. Moricand senior's interest in natural history developed gradually. He was interested in botany first and published between 1820 and 1847 in total 11 papers, in which he described 110 taxa, many of which belong to the family Fabaceae. His malacological interest developed later and started in 1834. Until 1851 he published six papers introducing 72 taxa, of which one nomen nudum and seven unavailable names under the ICZN Code. As Moricand senior never visited the Neotropics, he was depending on what others sent him; consequently his new taxa were focussed to a large extent on Brazil. Moricand junior published only four malacological papers within a relatively short time (1853-1860), with 16 new species; due to access to additional sources than Moricand senior, he was able to contribute to the Peruvian malacofauna.

Although this paper has been mainly written from a malacological point of view, we considered it fair to include the new botanical taxa described by Moricand senior, and his botanical eponyms, to do justice to these two sides of this amateur scientist from Geneva. And although the available documentation fails to provide enough detail of the apparently close relationships between Moricand senior, junior and Brot, we feel that at least some light is shed on their fruitful collaboration during the mid-19th century.

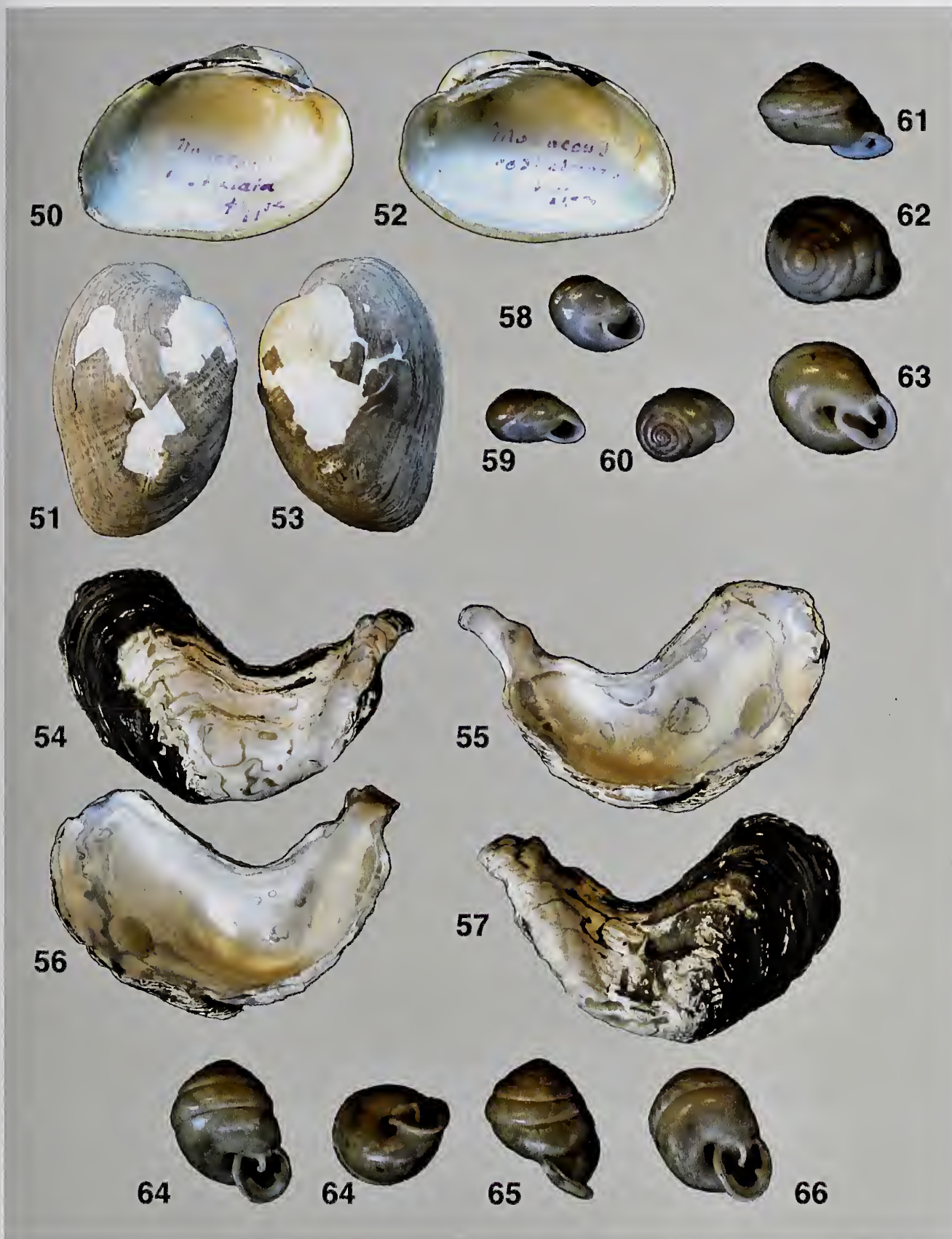
ACKNOWLEDGEMENTS

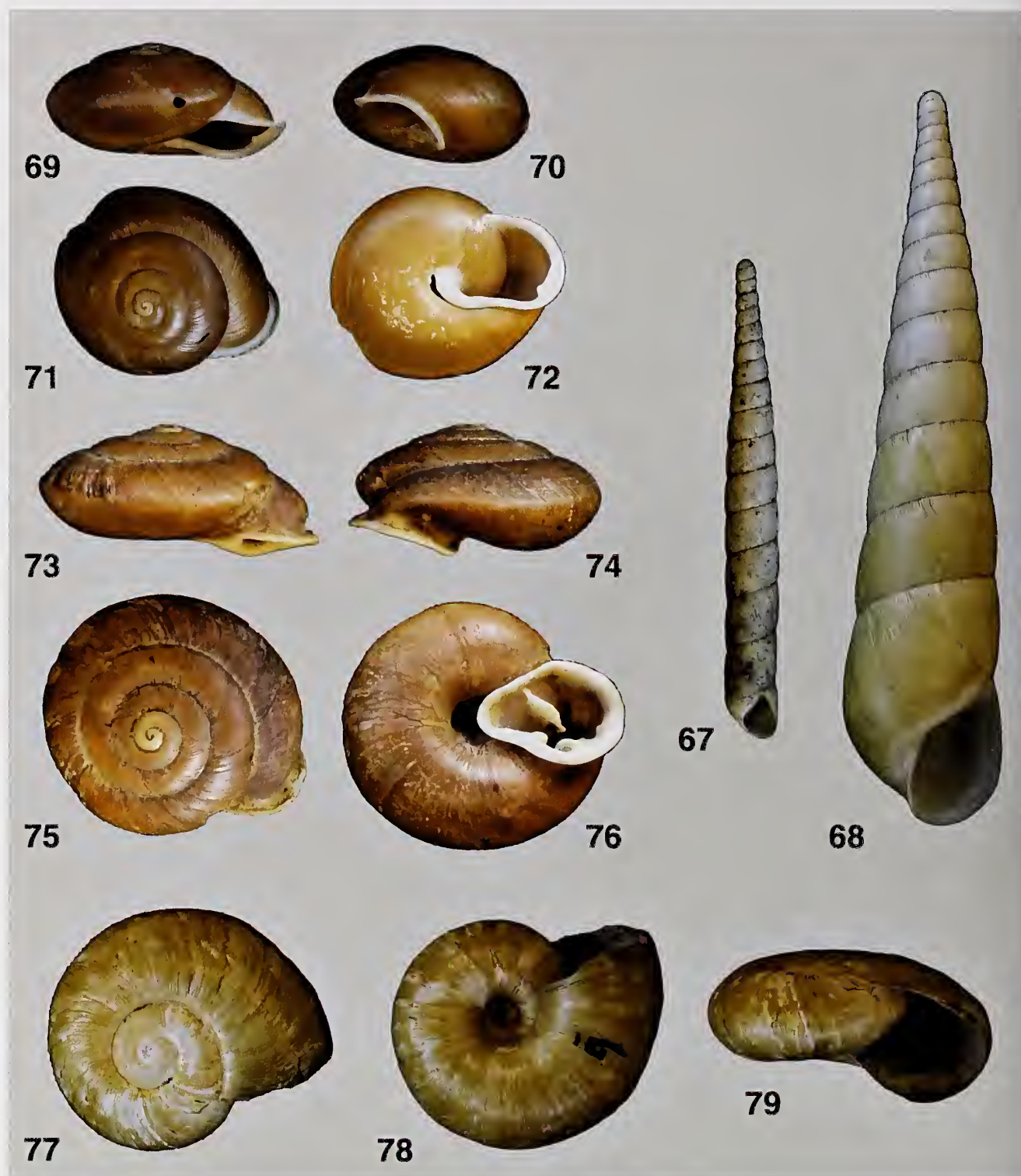
We are very grateful to B. Zezoni (MHNG librarian), who uncovered several sources from the Muséum's archive that were helpful to reconstruct the history of the Moricand collection. A. Buijsen (Naturalis librarian) and P. Emery (CJB librarian) kindly provided information on several botanical sources, and R. Herschler (Washington) sent a scanned label with Moricand's hand. Catherine de Jong (MHNG) helped with verifying the publication dates. J.J. Vermeulen (Leiden) guided us through the forest of botanical nomenclature to sort out the Moricand names and eponyms; his help is gratefully acknowledged. His comments and those of I. Richling (Stuttgart), and F.W. Stauffer (CJB) on the draft version, helped to improve this paper; their comments are here thankfully acknowledged.

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Figs 50-66. Unionidae, Etheriidae, and Streptaxidae. (50-53) Unionidae. (50-53) *Monocondylaea costulata* (J. Moricand, 1858), syntype, MHNG-INVE-91234 (D = 35.0). (54-57) Etheriidae. (54-57) *Bartlettia stefanensis* (J. Moricand, 1856), syntype, MHNG-INVE-91237 (D = 75.7). (58-66) Streptaxidae. (58-63) *Streptartemon comboides* (d'Orbigny, 1835), (58-60) syntype of *Helix (Cochlodonta) comboides brasiliensis* S. Moricand, 1836, MHNG-INVE-68684 (D = 9.01), (61-63) syntype of *Helix (Cochlodonta) comboides edentula* S. Moricand, 1836, MHNG-INVE-68683 (D = 6.30). (64-66) *Streptartemon streptodon* (S. Moricand, 1851), syntype, MHNG-INVE-68696 (D = 8.86). ►





Figs 67-79. Subulinidae, Pleurodontidae, and Haplotrematidae. (67-68) Subulinidae. (67) *Obeliscus subuliformis* (S. Moricand, 1836), syntype, MHNG-INVE-66259 (H = 28.7). (68) *Obeliscus obeliscus* (S. Moricand, 1834), holotype, MHNG-INVE-66256 (H = 84.4). (69-76) Pleurodontidae. (69-72) *Isomeria equestrata* (J. Moricand, 1858), syntype, MHNG-INVE-72607 (D = 38.6). (73-76) *Labyrinthus tarapotonensis* (J. Moricand, 1858), syntype, MHNG-INVE-72711 (D = 30.0). (77-79). Haplotrematidae. (77-79) *Austroselenites moyobambensis* (J. Moricand, 1858), syntype, MHNG-INVE-68036 (D = 27.2).



Figs 80-88. Streptaxidae, Euconulidae, and Charopidae. (80-82) Streptaxidae. (80-82) *Streptartemon cryptodon* (S. Moricand, 1851), syntype, MHNG-INVE-68687 (D = 3.68). (83-85) Euconulidae. (83-85) *Pseudoguppya semenlini* (S. Moricand, 1846), syntype, MHNG-INVE-70933 (D = 2.26). (86-88) Charopidae. (86-88) *Lilloiconcha pleurophora* (S. Moricand, 1846), syntype, MHNG-INVE-69077 (D = 2.15).

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APPENDIX. NOTES ON THE PUBLICATION DATES OF THE "MÉMOIRES DE LA SOCIÉTÉ DE PHYSIQUE ET D'HISTOIRE NATURELLE DE GENÈVE"

1. The "Mémoires" were published at irregular intervals in two parts ("partie") per volume ("Tome"). Most papers appeared with a line on the title page stating the date the content was read at a meeting of the Society. The journal was printed in consecutively numbered sheets of eight pages. We have researched especially S. Moricand's papers that were published in this journal and for which the date of publication may have taxonomic significance, i.e. Moricand 1834a, 1834b, 1835, 1836a, 1838, 1841a, 1846.
2. [Moricand 1834a, b] appeared both in livraison 2 of tome VI, on sheets 67-68. Both papers are without a date of

reading before a Society meeting, while the preceding paper (pp. 503-528, sheets 64-67) cites "Mémoire lu à la Société (...) le 18 Avril 1834", and the following paper (pp. 545-581, sheets 68-73) has "Mémoire lu à la Société (...) le 5 Juin 1834". Moricand's papers were thus likely published in the second half of 1834.

3. [Moricand 1835] was published as the last article in tome VII, 1^{re} partie, with "1835" on the title page; it comprised sheets 31-32. A preceding paper (pp. 191-221, sheets 24-28) has as subtitle "Lu à la Société (...) le 18 décembre 1834". Thus this paper was possibly published in 1835 (Stafleu & Cowan, 1981: 583 also suggest 1836).
4. [Moricand 1836a] appeared on pp. 414-446, sheets 51-55, of the second part of volume 7; according to its subtitle the paper was read before the Society on 18 June 1835. The following paper (pp. 447-455, sheets 55-56) was read on 17 December 1835. In the archives we found evidence that the date on the cover of this part ("1836") is correct.
5. The first part of volume 8 has "1838" printed on the cover. [Moricand 1838] was read at the meeting of 5 January 1837 of the Society, but other papers scattered throughout this part were only read as late as 18 January 1838 (p. 163). Therefore this part of the volume must have been published after this month. Since we found evidence in the archives that the second part of volume 8 was printed in 1839, we may assume that the first part was printed earlier, thus February-December 1838.
6. Moricand's second supplement [Moricand 1841] appeared in the first part of volume 9. It was read at the Society's meeting of 7 February 1838. The final paper in this part of the journal was read "le 17 Décembre 1840", and the issue probably appeared in print during 1841.
7. The final part on the Blanchet material [Moricand 1846] was read before the Society in May 1845 and was printed in the first part of volume 11. On page 253, however, a manuscript is shown to be written on 16 February 1846. This part of the volume is likely printed after that date, and in the archives we found evidence that the date on the cover of this part ("1846") is correct.

New and little known Epilamprinae (Dictyoptera: Blaberidae) from the collections of the Muséum d'histoire naturelle de Genève and the Zoological Institute RAS, Saint Petersburg.

Part 2

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Abstract: A new species of cockroach, *Gurneya rothi* sp. nov., is described from Brazil. *Rhabdoblatta erubescens* (Gerstaecker, 1883) and *Rh. punctipennis* (Saussure, 1895) are transferred to the genus *Africalolampra* Roth, 1995. A lectotype of *Audreia carinulata* (Saussure, 1895) is designated. The Neotropical genus *Audreia* Shelford, 1910 is ascribed to the tribe Morphinini McKittrick, 1964. A detailed morphological description of the new species is given, and *Africalolampra erubescens*, *A. punctipennis*, *Audreia carinulata* and *Pinaconota bifasciata* (Saussure, 1862) are redescribed. The male genitalia of *G. rothi* sp. nov., *Africalolampra erubescens*, *A. punctipennis* and the structures of ovipositor of *Africalolampra erubescens* and *Audreia carinulata* are described for the first time.

Keywords: *Gurneya rothi* sp. nov. - *Africalolampra erubescens* - *Africalolampra punctipennis* - *Audreia carinulata* - *Pinaconota bifasciata* - morphology.

INTRODUCTION

This work is a continuation of a planned series of papers devoted to dictyopterans in the collections of the Muséum d'histoire naturelle in Geneva. It also uses additional material from the collections of the Zoological Institute Russian Academy of Sciences, Saint Petersburg, Russia. The aim of this paper is to provide morphological descriptions of insufficiently known taxa which are detailed enough for further phylogenetic investigations. Special attention is paid to the structure of the male and female genitalia.

MATERIAL AND METHODS

The methods described in Anisyutkin (2014, 2015) were used. The present study follows Rehn's (1951) interpretation of the venation of the tegmina and wings. Description of the anterior margin of fore femur armament follows Bey-Bienko (1950) and Roth (2003). The terminology of male genital sclerites follows Klass (1997) with some modifications. The terminology used by Grandcolas (1996) for genital structures is given in parentheses. The terminology of the female genital structures follows McKittrick (1964) and Klass (1998). The terms introduced by the author (in the present work and in Anisyutkin, 2014) are given in quotation marks.

All material studied has been deposited in the Muséum d'histoire naturelle in Geneva, Switzerland (MHNG) or the Zoological Institute Russian Academy of Sciences in Saint-Petersburg, Russia (ZIN).

Abbreviation used in figures

(See text for further details):

- aa.* - anterior arch of second valvifer of the female genitalia;
- ap.scl.* - "apical sclerite" of the sclerite L2D in the male genitalia;
- bsv.* - basivalvula of the female genitalia;
- c.p.RIT* - caudal part of sclerite R1T of the male genitalia;
- a.R4* - additional sclerite of right phallomere of the male genitalia;
- b.L2D* - basal part of sclerite L2D of the male genitalia;
- b.L3* - basal subsclerite of the sclerite L3 in the male genitalia;
- b.o.* - "bent outgrowth" of basal part of the sclerite L2D in the male genitalia;
- b.pr.* - finger-like basal projection of sclerite L3 of the male genitalia (*sensu* Roth, 1974);
- bul.* - bulges at sides and in the middle of caudal margin of anal plate;
- ch.a.* - "chaeta-bearing areas" of the male genitalia;

- d.o.* - "dorsal outgrows" of apical part of the sclerite L2D in the male genitalia;
f.s. - "folded structure" of the sclerite L3 in the male genitalia;
gg. - gonangulum of the female genitalia;
hge - groove of the sclerite L3 in the male genitalia (*sensu* Klass, 1997);
l.scl. - lateral sclerites situated lateral to paratergites of ovipositor;
m.l. - membranous lobe of sclerite L3 of the male genitalia;
m.pl. - medial plate in the female genitalia;
out. - outgrowth at caudal end of sclerite L2D of the male genitalia;
par. - paraproct;
pl.s. - plate-like sclerite of the male genitalia;
r.scl. - rounded sclerite of right phallomere of the male genitalia;
L3, L4U, R1T, R2, R3, R4, R5 - sclerites of the male genitalia;
s.t. - "small tooth" of apical part of the sclerite L3 in the male genitalia;
scl. - large rectangular sclerite of the male genitalia;
sp. - spines of "apical sclerite" of the male genitalia;
tub. - cone-like tubercle of 1st abdominal tergite;
teVIII. - tergal process of the 8th abdominal tergite;
teIX. - tergal process of the 9th abdominal tergite;
v.I., v.III. - the 1st and 3rd valves of ovipositor respectively;
vs. - vestibular sclerite in the female genitalia.

TAXONOMIC PART

Genus *Africalolampra* Roth, 1995

Remarks: The genus *Africalolampra* initially comprised a single species, *A. ehrmanni*, from Kenya (Roth, 1995). The genus diagnosis used a complex of characters, including weak sexual dimorphism (tegmina and wings completely developed in both sexes), metatarsus with 2 rows of spines along lower margin, tarsal claws distinctly serrated, first abdominal tergite of male with medial specialization, left stylus absent (Roth, 1995).

The two species discussed below roughly correspond to the diagnosis of Roth, but *A. punctipennis* has a pronounced sexual dimorphism, tegmina and wings completely developed in the male, but distinctly shortened in the female, and an unspecialized first abdominal tergite (see description below). The structure of the head is markedly different in *A. erubescens* and *A. punctipennis* (compare Fig. 1 and 24 of present paper).

The structure of the male genitalia of *A. ehrmanni* was described only briefly. The statement that sclerite L2D (=L2d in Roth, 1995) of the male genitalia is not divided into a basal and apical part is probably erroneous because a small sclerotization is discernible on Fig. 4 in the original description (Roth, 1995). This sclerotization

could correspond to the "apical sclerite" of sclerite L2D (compare fig. 4 in Roth, 1995 and Figs 10, 11 of present paper).

Included species: The type species, *A. erubescens* (Gerstaecker, 1883) and *A. punctipennis* (Saussure, 1895).

Africalolampra erubescens (Gerstaecker, 1883)

Figs 1-19

Epilampra erubescens Gerstaecker, 1883: 54.

Heterolampra erubescens. - Kirby, 1904: 123.

Epilampra erubescens. - Shelford 1910: 14. - Rehn, 1933: 408, 451, pl. 32, fig. 6, 7. - Princis, 1962: 210, 230.

Material examined: MHNG; 1 male; "*Epilampra erubescens* Gerst.", "Kamerun L. Conradt 1898-1899", genital complex in prep. 100815/01. - ZIN; 2 males; "Mundanie Mungo Kamerun H. Rolle Berlin W.", "*Epilampra erubescens* Gerst.", "R. Shelford det.", "purchase [in Cyrillic L.A.] H. Rolle". - ZIN; 2 females; "Mundanie Mungo Kamerun H. Rolle Berlin W.", "purchase [in Cyrillic L.A.] H. Rolle". - ZIN; 1 female; "Mundanie Mungo Kamerun H. Rolle Berlin W.", "*Epil. erubescens* Gerst. R. Shelford det.", "purchase [in Cyrillic L.A.] H. Rolle".

Redescription of male: The original description and the description of Rehn (1933) can be supplemented with the following details. Most surfaces of body (head, pronotum, tegmina and abdomen) smooth and lustrous, distal parts of antennae (approximately from 15-16th segments) dull; very weak punctuation present in vertex, facial part of head, pronotum and proximal parts of tegmina, especially in costal field. Head about as long as wide or slightly wider than long (Fig. 1); ocellar spots small; facial part globular, without impression or wrinkles between eyes; distance between eyes 0.7-0.9 times eye length; distance between antennal sockets about 1.7-1.9 times scape length (0.8-1.0 mm); approximate length ratio of 3rd-5th segments of maxillary palps 1.2 : 1.0 : 1.2. Pronotum as in Fig. 2. Tegmina and wings completely developed, surpassing abdominal apex. Tegmina with rounded apex, coriaceous in proximal and membranous in distal parts; venation subobsolete in about proximal fourth, distinct in distal half; costal field long and narrow; *Sc* thickened (well visible on ventral side of tegmen) with 1-4 apical branches; *R*, *M* and *CuA* stems not separated basally; *CuP* distinct. Wings mostly membranous, with only weakly sclerotized area of anterior rami of *R*; *Sc* long and simple; *RA* long, with slightly incrassated anterior veins; *RS* weak; *M* long and simple; *CuA* pectinate with 4-5 complete (reaching wing margin) veins; behind *CuA* a long and simple vein, probably corresponding to 1st plical vein *sensu* Rehn (1951) or *CuP* [probably *CuP* + *Al sensu* Bey-Bienko (1950)]; next long and simple

vein probably corresponds to 3rd plial vein *sensu* Rehn (1951); between 1st and 3rd plial veins at base of wing located sclerotized field with short reduced vein, probably corresponds to 2nd plial vein *sensu* Rehn (1951); anal fan consisting of 16-17 veins reaching margin of wing; 2-3 possibly jugal veins situated behind anal fan. Fore tibiae not thickened distally. Anterior margin of fore femora of armed type B, with 5-7 spines, including 2 apical one. Tibial spines well developed. Structure of hind tarsi: metatarsus about as long as other segments combined; euplantulae of 1st-4th segments small and apical; metatarsus with 2 more or less equal rows of spines along lower margin; "additional spines" bordering euplantulae of 2nd-3rd segments from inside and outside present; claws symmetrical, very weakly serrated; arolium distinct, about as half as claw length. Abdomen with 1st tergite specialized (Fig. 3): small cone-shaped tubercle (Fig. 3, *tub.*) situated in medial hollow, the anterior part of this tubercle densely covered with hair. First and, in lesser degree, following abdominal tergites with membranous strip along caudal margin (Fig. 3). Anal plate (tergite X) short and transverse, nearly rectangular, caudal margin weakly concave, without medial incision (Figs 4, 6); three small more or less expressed bulges located at sides and in the middle of caudal margin of anal plate (Figs 4, 5, *bul.*). Cerci with distinct segments. Paraprocts of blaberid-type (Figs 4-6, *par.*). Hypandrium asymmetrical, caudal margin angularly projected caudally; right stylus cylindrical, left stylus absent (Fig. 7). Genitalia (Figs 8-15). Right phallomere (R+N): sclerite R1T well sclerotized, serrated, caudal part of R1T in shape of separated large plate-like sclerite (Figs 8, 9, *pl.s.*), lateral part of this sclerite probably correspond to sclerite R4 (Figs 8, 9, *R4?*); bristles absent; R2 slightly curved, without hollow; R3 "V"-shaped, with long and thin branches; R4 probably fused with large plate-like sclerite; R5 large, well sclerotized, plate-like. Sclerite L2D (L1) divided into basal and apical parts (Figs 10, 11); basal part rod-like, with outgrowth at caudal end (Fig. 11, *out.*); "apical sclerite" small, thimble-like; bristles absent (Fig. 11, *ap.scl.*). Sclerite L3 (L2d) without basal subsclerite, "folded structure" and bristles present (Figs 12-15, *f.s.*); apex of L3 with attenuated "small tooth" (Figs 13-15, *s.t.*); "apical crest" and groove *hge* absent. Sclerite L4U (L3d) distinct, plate-like (Fig. 12).

Redescription of female: Similar to male, but body slightly more robust and ovoid. Distance between antennal sockets of the head about 2.0 times of the scape length (0.9-1.0 mm); approximate length ratio of 3rd-5th segments of maxillary palps 1.0 : 1.0 : 1.1. Abdomen without visible glandular specializations. Anal plate (tergite X) trapezoidal, with distinct median incision on caudal margin (Fig. 16). Paraprocts medially membranous (Fig. 18, *par.*). Genital plate as in Fig. 17. Ovipositor and adjacent structures (Figs 18, 19):

Intercalary sclerite absent; tergal processes of abdominal segment VIII not reaching paratergites of VIII tergite (Fig. 18, *teVIII.*); tergal processes of abdominal segment IX completely developed (Fig. 18, *teIX.*). Two rounded sclerites (Fig. 18, *l.scl.*) situated lateral to paratergites. Gonangulum distinct, well sclerotized (Figs 18, 19, *gg.*). First valves of ovipositor large and membranous at apex (Fig. 18, *v.I.*), with setae (not shown in Fig. 18) along inner side. Base of 2nd and 3rd pairs of valves as in Fig. 19. Anterior arch of second valvifer as in Fig. 19, *aa.* 2nd valves of ovipositor small. 3rd valves of ovipositor (gonoplares) wide, partly membranous (Fig. 18, *v.III.*). Basivalvulae weakly sclerotized, in shape of two slightly asymmetrical plates with reflexed outer margins (Figs 18, 19, *bsv.*). Vestibular sclerite weakly sclerotized, horseshoe-like, with articulated lateral parts (Figs 18, 19, *vs.*). Brood sac membranous, with indistinct weakly sclerotized medial plate (Fig. 18, *m.pl.*).

Measurements (in mm): Head length: male 3.4-3.7, female 4.0-4.2; head width: male 3.6-3.7, female 4.1-4.2; pronotum length: male 5.0, female 5.5-6.4; pronotum width: male 6.2-6.8, female 7.5-8.2; tegmen length: male 19.9-20.3, female 21.2-21.7; tegmen width: male 6.0-6.5, female 6.7-7.6.

Note: This species was described from Cameroon (Gerstaecker, 1883) in the genus *Epilampra* Burmeister, 1838 and transferred into the genus *Rhabdoblatta* Kirby, 1903 by Princis (1967). *Africalolampra erubescens* is probably relatively frequent in West Africa (Rehn, 1933).

Africalolampra punctipennis (Saussure, 1895)

Figs 24-37

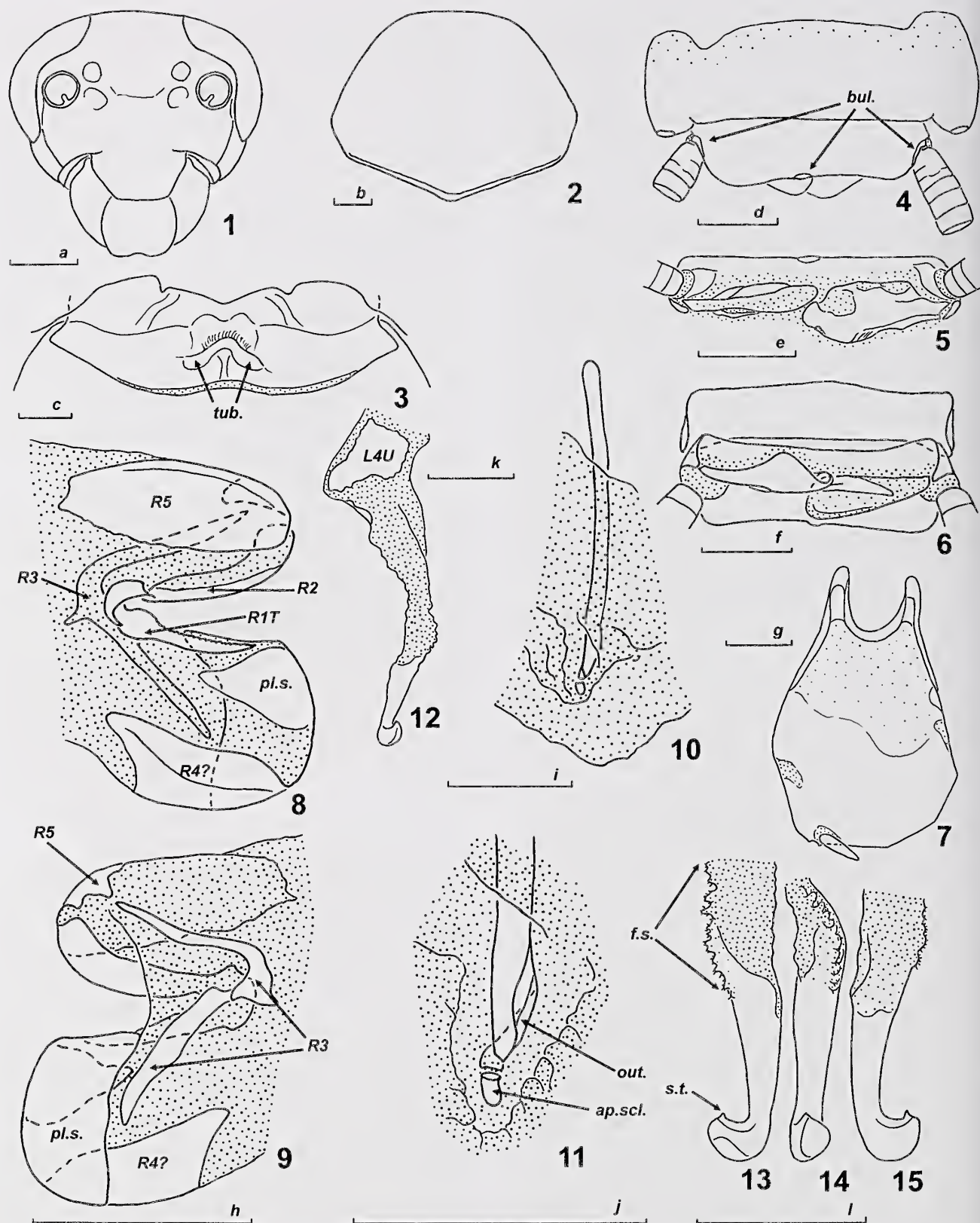
Epilampra punctipennis Saussure, 1895: 355, 356, pl. 9 fig. 12.

Heterolampra punctipennis. – Kirby, 1904: 123.

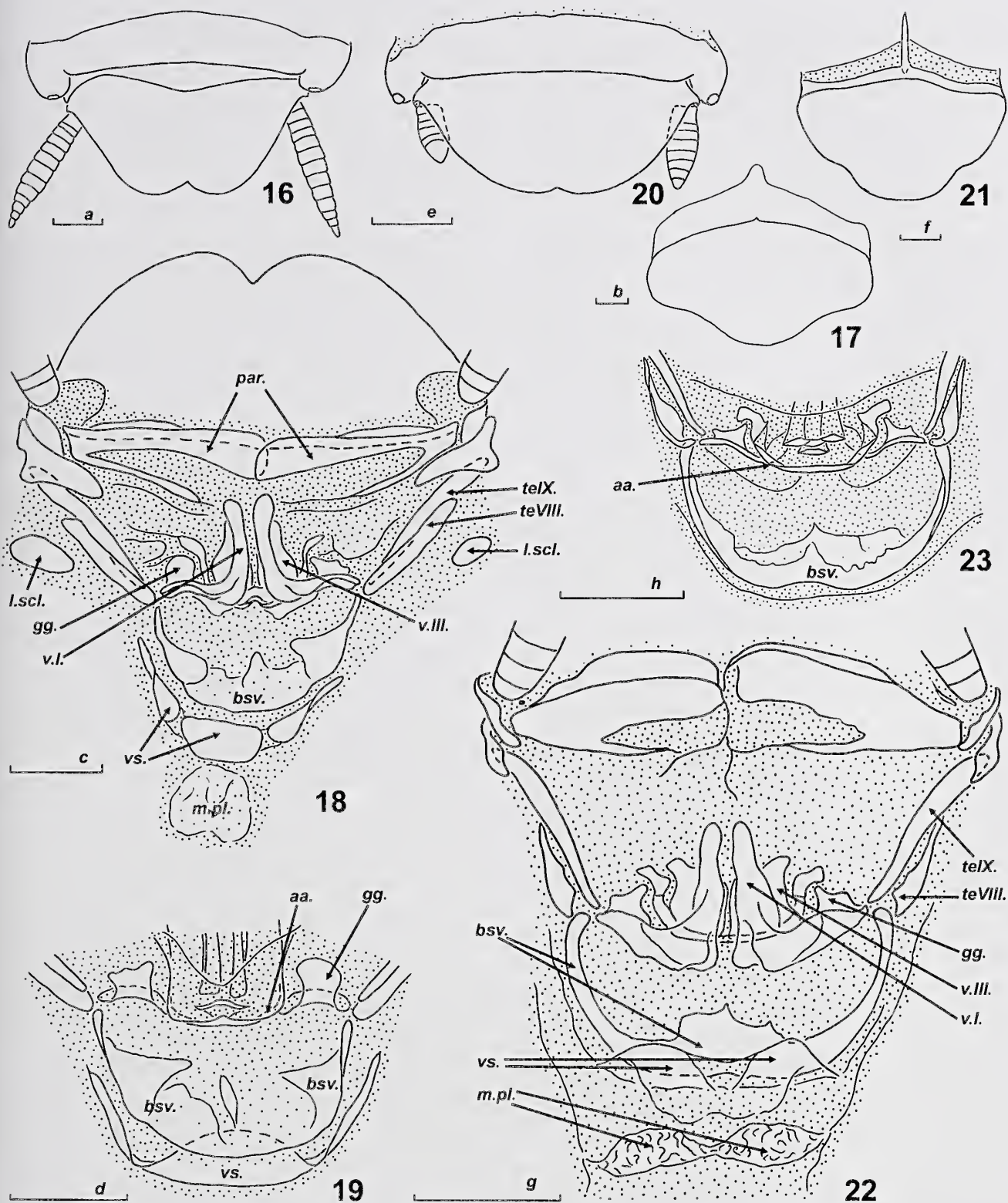
Epilampra punctipennis. – Shelford, 1910: 14. – Princis, 1963: 200.

Material examined: MHNG; 1 male; "Daressalam. Afrique orient. allemande. Dr J. Carl.", "Gen. M", "*Epilampra punctipennis* (Sauss). ♂", genital complex in prep. 100815/02.

Redescription of male: General colour light yellowish with small scattered brownish spots. Eyes black; ocellar spots pale; facial part of head above antennal sockets brownish. Surfaces smooth and lustrous, distal parts of antennae (approximately from 12-13th segments) and 5th segment of maxillary palps dull; punctuation very weak, present only in proximal parts of tegmina. Head longer than wide (Fig. 24); ocellar spots large; facial part with distinct impression between eyes and weak transverse wrinkles above antennal sockets, between eyes; distance between eyes 0.3 times eye length;



Figs 1-15. *Africalolampra erubescens* (Gerstaecker, 1883), male. (1) Facial part of head. (2) Pronotum, dorsal view. (3) First abdominal tergite, dorsal view. (4) Abdominal apex, dorsal view. (5) The same, caudal view. (6) The same, hypandrium and genitalia removed, ventral view. (7) Hypandrium, ventral view. (8) Right phallomere, dorsal view. (9) The same, ventral view. (10) Sclerite L2D, dorsal view. (11) Caudal part of sclerite L2D, dorsal view. (12) Sclerites L3 and L4U. (13-15) Apex of sclerite L3. Dotted areas show membranous parts. Abbreviations: *ap.scl.*, *bul.*, *f.s.*, *L4U*, *out.*, *pl.s.*, *R1T*, *R2*, *R3*, *R4?*, *R5*, *s.t.*, *tub.* - see chapter "abbreviation used in figures", for details see text. Scale bars 1 mm: a = 1, b = 2, c = 3, d = 4, e = 5, f = 6, g = 7, h = 8, 9, i = 10, j = 11, k = 12, l = 13-15.



Figs 16-23. Females of *Africalolampra erubescens* (Gerstaecker, 1883) (16-19) and *Audreia carinulata* (Saussure, 1895), paralectotype (20-23). (16, 20) Abdominal apex, dorsal view. (17, 21) Genital plate, ventral view. (18, 22) Abdominal apex, ventral view, genital plate removed. (19, 23) Basal part of ovipositor, view from within. Dotted areas show membranous parts. Abbreviations: aa., bsv., gg., l.scl., m.pl., par., telX., teVIII., v.I., v.III., vs. - see chapter "abbreviation used in figures", for details see text. Scale bars 1 mm: a = 16, b = 17, c = 18, d = 19, e = 20, f = 21, g = 22, h = 23.

distance between antennal sockets about 1.8 times scape length (0.7 mm); approximate length ratio of 3rd-5th segments of maxillary palps 1.0 : 1.0 : 1.0. Pronotum as in Fig. 25. Tegmina and wings completely developed, surpassing abdominal apex. Tegmina with rounded apex, sclerotized in costal and, in lesser degree, anal fields; venation distinct; costal field wide; *Sc* thickened (well visible on ventral side of tegmen); *R* and *M* stems basally fused; *CuP* distinct. Wings membranous, without sclerotized areas; *Sc* long and simple; *RA* long, with few anterior veins; *RS* distinct; *M* long and simple; *CuA* pectinate with 5 complete (reaching wing margin) veins; behind *CuA* a long and simple vein, probably corresponding to 1st plical vein *sensu* Rehn (1951) or *CuP* [probably *CuP* + *A1* *sensu* Bey-Bienko (1950)]; next vein short and reduced, proximally incrassated, not reaching wing margin, probably corresponds to 2nd or 3rd plical veins *sensu* Rehn (1951); anal fan consisting of 14-15 veins reaching margin of wing; 3-4 possibly jugal veins situated behind anal fan. Fore tibiae not thickened distally. Anterior margin of fore femora of armed type B, with 4-5 spines, including 1-2 apical ones. Tibial spines well developed. Structure of hind tarsi similar to those of *A. erubescens* (see description above). Abdomen without visible glandular specializations. Anal plate (tergite X) short and transverse, caudal margin weakly sinuate, without medial incision (Fig. 26). Cerci with distinct segments (Fig. 26). Paraprocts of blaberid-type (Fig. 27). Hypandrium asymmetrical, caudal margin widely rounded; right stylus small, left absent (Fig. 28).

Genitalia (Figs 29-37): Right phallomere (R+N): sclerite R1T well sclerotized, weakly curved, caudal part R1T slightly separated, with shape of large plate-like sclerite (Figs 29, 30, *pl.s.*), lateral part of this sclerite probably corresponds to sclerite R4 (Figs 29, *R4?*); bristles absent; R2 slightly curved; R3 "V"-shaped, with long, thin and slightly curved branches; R4 probably fused with large plate like sclerite; R5 large, plate-like. Sclerite L2D (L1) not divided into basal and apical parts, widened cranially (Fig. 31); apex of L2D in shape of convoluted thorn (Figs 32-34). Sclerite L3 (L2d) without basal subsclerite, "folded structure" and bristles present (Figs 35-37, *f.s.*); apex of L3 blunt; "apical crest" and groove *hge* absent. Sclerite L4U (L3d) distinct, triangular.

Female (not studied by the author): Widely ovoid in shape, with tegmina and wings shortened, not reaching abdominal apex (Saussure, 1895, fig. 12).

Measurements (in mm): Head length 3.2, head width 2.9; pronotum length 5.3, pronotum width 8.2; tegmen length 19.2, tegmen width 7.0.

Note: This species was described in the genus *Epilampra* based on female specimens (at least two specimens – the number seen is unclear from the original description) from Zanzibar (Saussure, 1895).

Later *E. punctipennis* was transferred into the genus *Rhabdoblatta* by Princis (1967).

Genus *Audreia* Shelford, 1910

Type species: *Calolampra carinulata* Saussure, 1895, by subsequent designation.

Remarks: The genus *Audreia* was diagnosed in the original description as follows: "Differs from *Calolampra* by the reduced tegmina of the male, which fail to reach the apex of abdomen and by the tegmina of the female, which are sub-quadrate or absent" and originally included 8 species (arranged as in the original description): *A. pulchra* Shelford, 1910, *A. truncata* (Brunner von Wattenwyl, 1865), *A. biolleyi* (Saussure, 1895), *A. carinulata* (Saussure, 1895), *A. cicatricosa* Rehn, 1903, *A. hamiltoni* Rehn, 1903, *A. heusseriana* (Saussure, 1864) and *A. catharina* Shelford, 1910 (Shelford, 1910, p. 11). The type species was not designated by Shelford. *Audreia carinulata* was subsequently selected as the type species by Hebard (1920).

Later, Roth (1970) considered the genus *Audreia* in detail and restricted it to a single species – *A. carinulata*. In 1976 Gurney and Roth wrote: "The type species of *Audreia*, *Calolampra carinulata* Saussure, designated by Hebard (1920: 92), appears generically distinct from *Epilampra*." (Gurney, Roth, 1976, p. 80). Nevertheless, *Audreia* was synonymized with *Epilampra* by Fisk & Schal (1981) and restored by Lopes *et al.* (2010). Later, doubts were expressed about *Audreia* belonging to the tribe Epilamprini (Lopes *et al.*, 2014).

The detailed description of the male genital structures of *A. carinulata* (see description below) suggest a strong similarity with those of the genera *Morphna* Shelford, 1910, *Rhabdoblatta*, Kirby, 1903 and other genera of the tribe Morphnini McKittrick, 1964. There is a similar structure of the right phallomere and sclerite L2D (compare Figs 46-55 and Anisyutkin, 1999, 2000, 2003, 2014). In the author's opinion, the genus *Audreia* undoubtedly belongs to the tribe Morphnini.

Included species: At the present time only the type species, *A. carinulata* (Saussure, 1895), can be undoubtedly included in the genus.

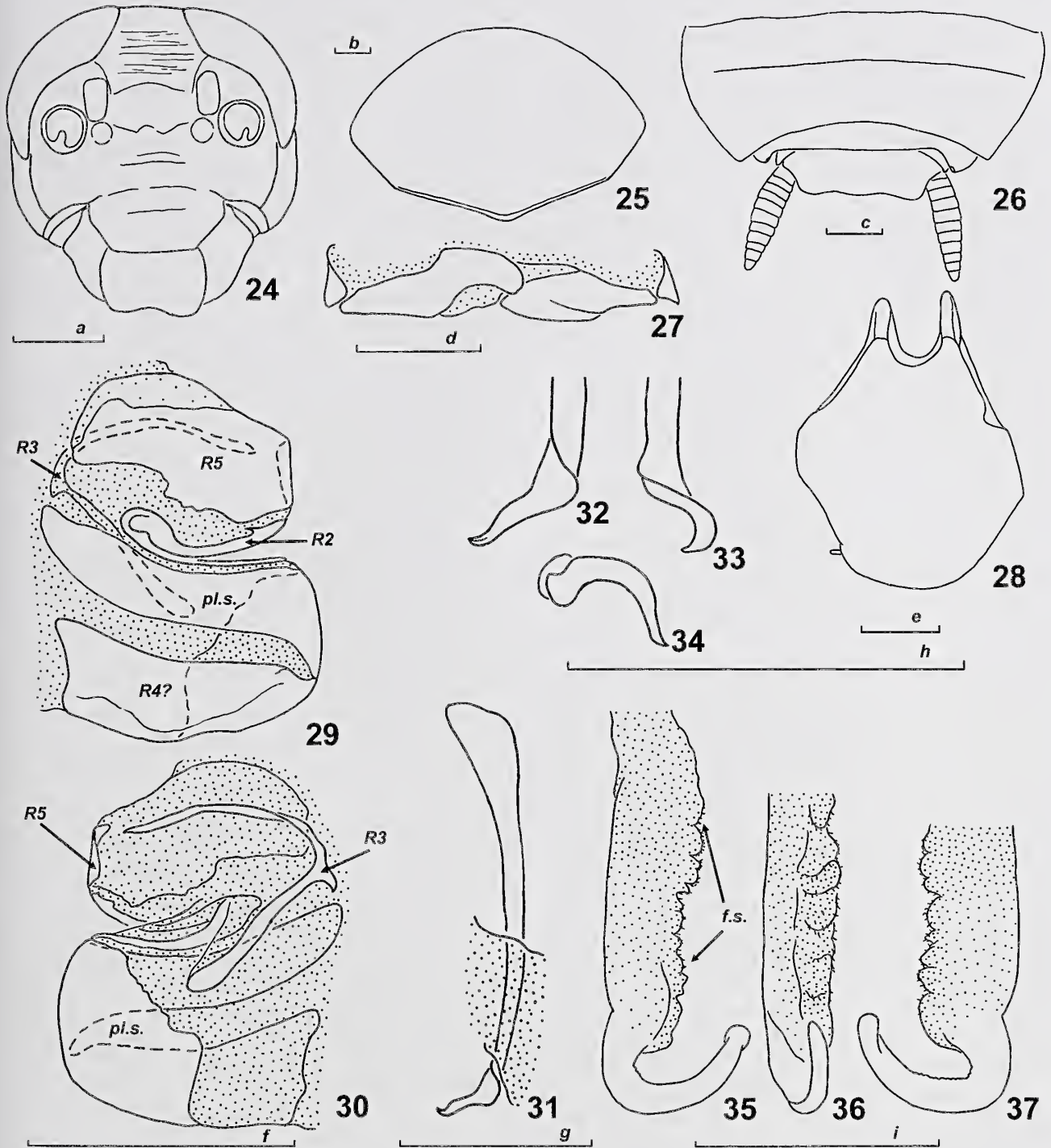
Audreia carinulata (Saussure, 1895)

Figs 20-23, 38-58

Calolampra carinulata Saussure, 1895: 345-347, pl. 9 fig. 9. – Kirby, 1904: 117. – Shelford, 1910: 11.

Audreia carinulata. – Hebard, 1920: 92. – Princis, 1967: 658. – Roth, 1970: 464, figs 347-352. – Gurney & Roth, 1976: 80.

Epilampra carinulata. – Fisk & Schal, 1981: 694, 695.



Figs 24-37. *Africalolampra punctipennis* (Saussure, 1895), male. (24) Facial part of head. (25) Pronotum, dorsal view. (26) Abdominal apex, dorsal view. (27) Paraprocts, ventral view. (28) Hypandrium, ventral view. (29) Right phallomere, dorsal view. (30) The same, ventral view. (31) Sclerite L2D, dorsal view. (32, 33) Caudal part of sclerite L2D. (34) The same, caudal view. (35-37) Apex of sclerite L3. Dotted areas show membranous parts. Abbreviations: *f.s.*, *pl.s.*, *R2*, *R3*, *R4?*, *R5* - see chapter "abbreviation used in figures", for details see text. Scale bars 1 mm: a = 24, b = 25, c = 26, d = 27, e = 28, f = 29, 30, g = 31, h = 32-34, i = 35-37.

Material examined:

Lectotype: MHNG; Lectotype, designated herewith; male; "620 76 Costa-Rica Amer. cent", "74", "*Calolampra carinulata* ♂ Sss.", genital complex in prep. 100815/03. **Paralectotypes:** MHNG; 2 males; same data as lectotype. – 2 males; "620 76 Costa-Rica Amer. cent", "*Calolampra carinulata* # Sss.". – 2 females; "620 76 Costa-Rica Amer. cent", "5.", "*Calolampra carinulata* Sss.". – 1 female; "620 76 Costa-Rica Amer. cent", "73", "*Calolampra carinulata* ♀ Sss.", genital complex in prep. 100815/05. – 1 female; "620 76 Costa-Rica Amer. cent", "*Calolampra carinulata* ♀ Sss.". – 1 female; "620 76 Costa-Rica Amer. cent", "La Palula 73 1600 m D. Biolley". – 2 females; "Volcan de Barba. Amer. cent. Mr. H. de Saussure", "Musée San José No 5.", "*Calolampra carinulata* ♀ Sauss.". – 5 females; "*Calolampra carinulata* Biolley 73". 2 females; "*Calolampra carinulata* Biolley ♀ 73". – MHNG, labelled in box as "*carinulata* var. *pallida*": 1 male; "620 76 Costa-Rica Amer. cent", "21.", labelled as *carinulata* var. *pallida*, genital complex in prep. 100815/04. – 1 male; "620 76 Costa-Rica Amer. cent", "76.", "*Calolampra carinulata* # Sss". 1 female; "San José. Amer. cent. Mr. H. de Saussure", "Musée San José No 11.", "*Calolampra carinulata* Sauss. var. *pallida*". – 1 larva; "620 76 Costa-Rica Amer. cent", "*Calolampra carinulata* ♂ larva Sauss.". – 1 larva; "620 76 Costa-Rica Amer. cent", "21", "*Calolampra carinulata* Sss. larva ♂".

Redescription of male (lectotype): General colour reddish-brown with scattered small dark dots. Eyes and 5th (ultimate) segment of maxillary palps black. Scapi, mouthparts (with exception of 5th segment of maxillary palps) and legs dirty yellowish. Surfaces smooth and lustrous, distal parts of antennae (from 14th segments) dull; very weak punctuation present in tegmina. Head about as long as wide (Fig. 38); ocellar spots small; facial part globular, without impression or wrinkles between eyes; distance between eyes about as long as eye length; distance between antennal sockets about 1.7 times scape length (0.8 mm); approximate length ratio of 3rd-5th segments of maxillary palps 1.0 : 1.0 : 1.4. Pronotum as in Fig. 39. Tegmina strongly shortened, about as long as wide (Fig. 40), reaching 3rd abdominal tergite; venation obsolete, thickened *Sc* visible only on ventral side of tegmina, remnants of *CuP* discernible on dorsal side. Wings vestigial, completely hidden under tegmina. Fore tibiae not thickened distally. Anterior margin of fore femora of armed type B, with 4-5 spines, including 1-2 apical one. Tibial spines well developed. Structure of hind tarsi: metatarsus about as long as other segments combined; euplantulae of 1st-4th segments small and apical; metatarsus with 2 more or less equal rows of spines along lower margin; "additional spines" bordering euplantulae of 2nd-3rd segments from inside and outside present; claws symmetrical, simple; arolium small, less than half of claw length. Abdomen without

glandular specializations. Anal plate (tergite X) partly membranous, trapezoidal in shape, caudal margin weakly concave, without medial incision (Fig. 41). Cerci short, with distinct segments. Paraprocts of blaberid-type (Fig. 42, *par.*). Hypandrium asymmetrical, caudal margin membranous, concave; right stylus flattened and weakly sclerotized, left stylus absent (Figs 43, 44).

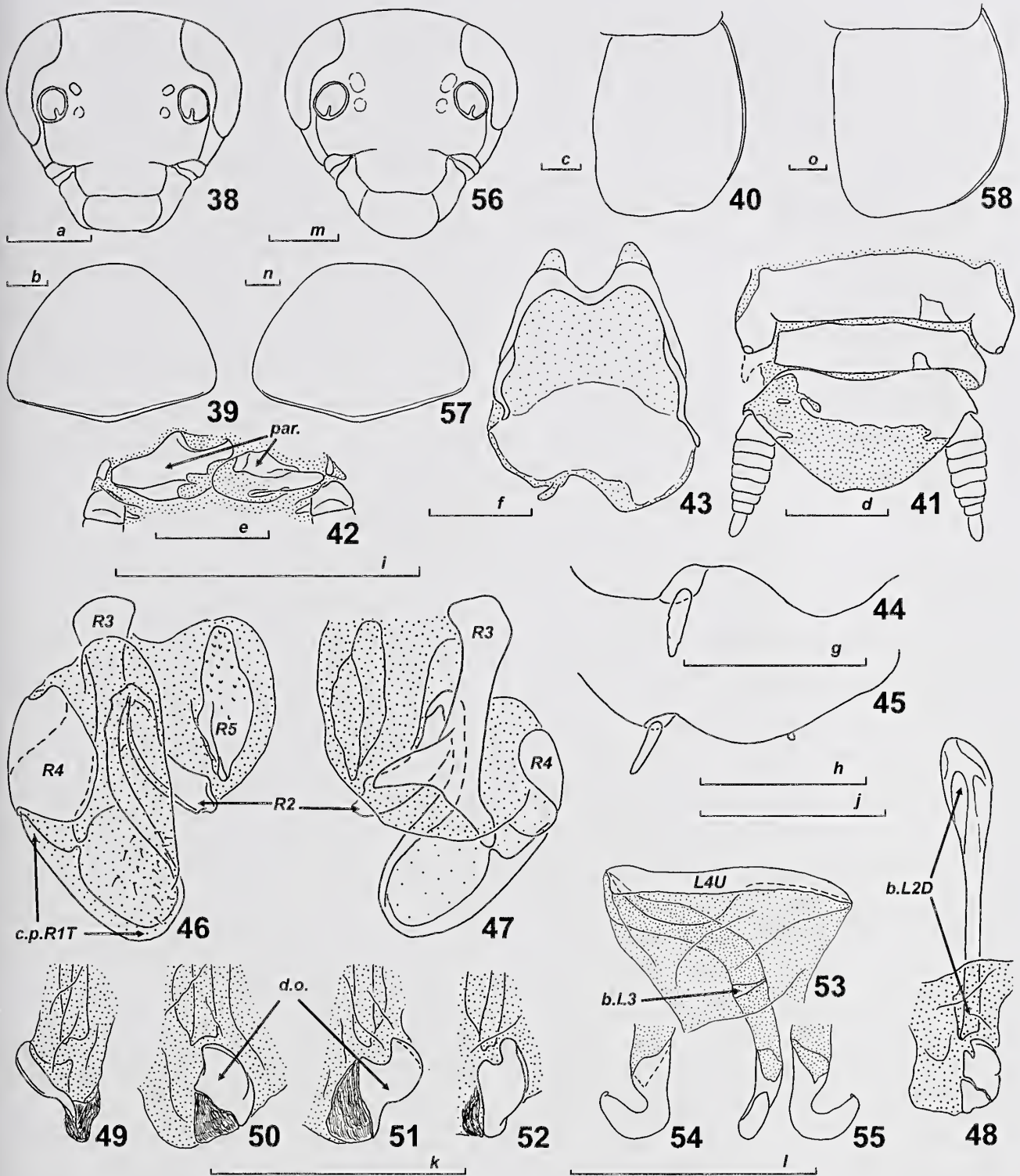
Genitalia (Figs 46-55). Right phallomere (R+N): caudal part of sclerite R1T well sclerotized, subrectangular in shape, with rounded apex (Figs 46, 47, *c.p.R1T*), covered with bristles; R2 weakly curved; R3 subtriangular, widened caudally; R4 large, plate-like; R5 plate-like, situated in dorsal side of phallomere, partly covered with very small tubercles. Sclerite L2D (L1) divided into basal and apical parts (Figs 48-51); basal part rod-like, distinctly widened cranially (Fig. 48, *b.L2D*); "apical sclerite" densely covered with bristles; "dorsal outgrowth" large (Figs 49-52, *d.o.*); Sclerite L3 (L2d) small, with basal subsclerite, (Fig. 53, *b.L3*); "folded structure", bristles, "apical crest" and groove *hge* absent. Sclerite L4U (L3d) large (Fig. 53).

Variation (paralectotypes): Antennae dull from 12th segments. Caudal margin of hypandrium more rounded, as compared with that of lectotype; left stylus present as very small vesicle (Fig. 45). "Dorsal outgrowth" of "apical sclerites" slightly vary in shape (Fig. 52, *d.o.*).

Redescription of female: Similar to male, but larger. Antennae dull from 11-12th segments. Head with distance between eyes 1.1 times eye length (Fig. 56); distance between antennal sockets about 1.6 times of the scape length (0.9 mm); approximate length ratio of 3rd-5th segments of maxillary palps 1.3 : 1.0 : 1.3. Pronotum and tegmen as in Figs 57, 58. Anal plate transverse, caudal margin widely rounded with weak medial incision (Fig. 20). Cerci shortened, as compared with male (Fig. 20). Genital plate as in Fig. 21.

Ovipositor and adjacent structures (Figs 22, 23): Intercalary sclerite absent; tergal processes of abdominal segment VIII not reaching paratergites of VIII tergite (Fig. 22, *teVIII.*); tergal processes of abdominal segment IX completely developed (Fig. 22, *teIX.*). Gonangulum distinct, well sclerotized (Figs 18, 19, *gg.*). First valves of ovipositor large and membranous at apex (Fig. 22, *v.I.*), with setae (not shown in Fig. 22) along inner side. Base of 2nd and 3rd pairs of valves as in Fig. 23. Anterior arch of second valvifer as in Fig. 23, *aa.* 2nd valves of ovipositor small. 3rd valves of ovipositor (gonopods) wide, partly membranous (Fig. 22, *v.III.*). Basivalvulae well sclerotized, semicircular, not divided into two parts, with reflexed outer margins (Figs 22, 23, *bsv.*). Vestibular sclerite weakly sclerotized, bilobed (Fig. 22, *vs.*). Brood sac membranous, with indistinct weakly sclerotized medial plate (Fig. 22, *m.pl.*).

Measurements (in mm): Head length: male 2.5-2.7 (2.5), female 3.1-3.4; head width: male 2.5-2.8 (2.6),



Figs 38-58. *Audreia carinulata* (Saussure, 1895), males: lectotype (38-44, 46-51, 53-55), paralectotype (45, 52), female, paralectotype (56-58). (38, 56) Facial part of head. (39, 57) Pronotum, dorsal view. (40, 58) Left tegmen, dorsal view. (41) Abdominal apex, dorsal view. (42) Paraprocts, ventral view. (43) Hypandrium, ventral view. (44, 45) Caudal margin of hypandrium, ventral view. (46) Right phallomere, dorsal view. (47) The same, ventral view. (48) Sclerite L2D, dorsal view. (49, 51) Caudal part of sclerite L2D, seen from outside. (50, 52) The same, dorsal view. (53) Sclerites L3 and L4U. (54, 55) Apex of sclerite L3. Dotted areas show membranous parts. Abbreviations: b.L2D, b.L3, c.p.R1T, d.o., L4U, R2, R3, R4, R5, par. — see chapter "abbreviation used in figures", for details see text. Scale bars 1 mm: a = 38, b = 39, c = 40, d = 41, e = 42, f = 43, g = 44, h = 45, i = 46, 47, j = 48, k = 49-52, l = 53-55, m = 56, n = 57, o = 58.

female 3.1-3.5; pronotum length: male 3.5-4.0 (3.5), female 4.1-5.1; pronotum width: male 4.6-5.4 (4.7), female 5.5-7.0; tegmen length: male 4.5-5.0 (4.5), female 4.8-6.2; tegmen width: male 3.5-4.0 (3.5), female 4.0-5.0. Measurements in parenthesis are those of lectotype.

Note: In the author's opinion, the series labelled "*carinulata* var. *pallida*" do not deserve a separation at the infraspecific level as they differ only in the slightly lighter colouration.

Genus *Gurneya* Roth, 1974

Remarks: This genus initially comprised a single species, *G. obliqua*, from Brazil (Beccaloni, 2015).

Included species: The type species and *G. rothi* sp. nov.

Gurneya rothi sp. nov.

Figs 59-70

Etymology: The species is named in honor of Dr. Louis Roth, famous specialist in cockroach taxonomy.

Material examined: Holotype; ZIN; male; Brazil, "Bahia", "*Pinaconota bifasciata* Sauss.", "R. Shelford det.", genital complex in prep. 120815/01.

Description of male (holotype): General colour dirty yellowish; epicranium and two proximal antennal segments brownish; eyes grey; antennae, with exception of two proximal segments, grey, yellowish toward apex; maxillary and labial palps, tegmina in about distal half, wings and abdomen yellow; pronotum with 2 black stripes (Fig. 60). Surfaces smooth and lustrous, distal parts of antennae (approximately from 7-8th segments) dull; head (Fig. 59), pronotum and tegmina in about proximal third with deep punctuation. Head about as long as wide (Fig. 59); ocellar spots absent; facial part globular, with weak semicircular plate between eyes; distance between eyes 0.8 times eye length; distance between antennal sockets about 1.7 times scape length (0.9 mm); approximate length ratio of 3rd-5th segments of maxillary palps 1.5 : 1.0 : 1.3. Pronotum widely rounded anteriorly with weakly angulate caudal margin (Fig. 60). Tegmina and wings completely developed, surpassing abdominal apex. Tegmina with rounded apex; venation subobsolete in proximal fourth, distinct in distal half; costal field long and narrow with obsolete venation; *Sc* thickened (well visible on ventral side of tegmen); *R*, *M* and *CuA* stems not separated basally; *CuP* distinct. Wings membranous, *Sc* in length as half as wing; *RA* with 5-6 not incrassated anterior veins; *RS* with 6 veins; *M* long and simple; *CuA* pectinate with 3 complete (reaching to wing margin) veins; behind *CuA* a long and simple vein, probably corresponding to 1st plical vein *sensu* Rehn (1951) or *CuP* [probably *CuP*

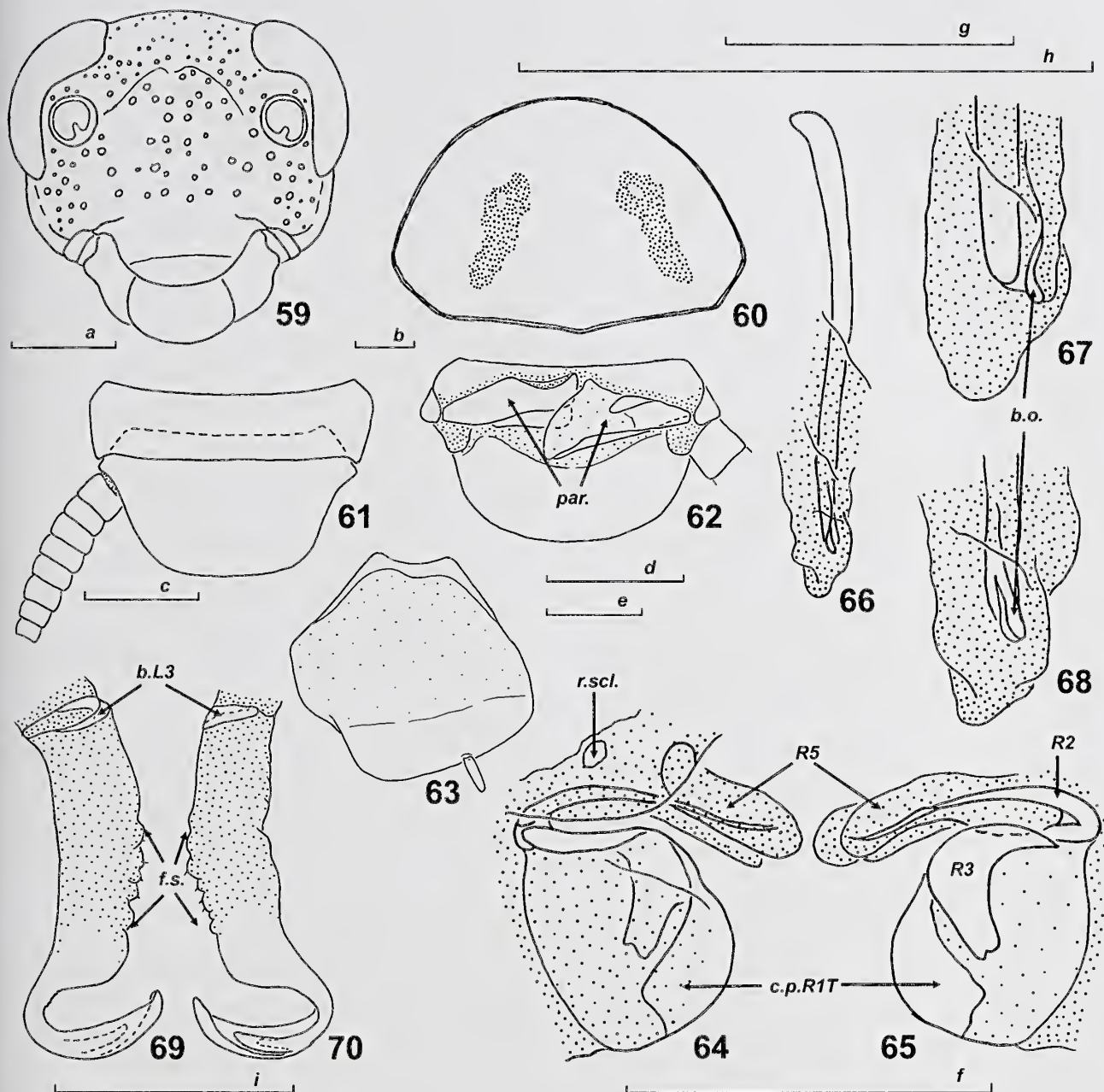
+ *A1 sensu* Bey-Bienko (1950)]; next long and simple vein probably corresponds to 3rd plical vein *sensu* Rehn (1951); between 1st and 3rd plical veins located shorter vein not reaching wing margin, probably corresponds to 2nd plical vein *sensu* Rehn (1951); anal fan consisting of 11 veins reaching margin of wing; 2 possibly jugal veins situated behind anal fan. Fore tibiae not thickened distally. Anterior margin of fore femora of armed type A, with 25-27 bimarginally serrated spines and 1 not bimarginally serrated apical one. Tibial spines well developed. Structure of hind tarsi: metatarsus shorter than other tarsal segments combined, with euplantula more than one half segment length; euplantulae of 2nd-4th segments large; tarsal spines completely absent, replaced with irregularly placed bristles; claws symmetrical and simple; arolium longer than half of claw length. Abdomen without visible glandular specializations. Anal plate (tergite X) trapezoidal in shape, caudal margin rounded, without medial incision (Figs 61, 62). Cerci with distinct segments. Paraprocts of blaberid-type (Fig. 62, *par.*). Hypandrium asymmetrical and transverse, caudally rounded; left stylus cylindrical, right stylus broken off (Fig. 63).

Genitalia (Figs 64-70): Right phallomere (*R+N*): sclerite *R1T* with caudal part wide (Figs 64, 65, *c.p.R1T*); bristles absent; *R2* long and sinuate; *R3* crescentic, closely associated with *R1T*; *R4* absent; *R5* replaced with unsclerotized lobe. Cranial and above right phallomere situated small rounded sclerite of unclear homology (Fig. 64, *r.scl.*). Sclerite *L2D* (*L1*) not divided into basal and apical parts (Fig. 66), slightly bent cranially, with "bent outgrowth" at caudal end (Figs 67, 68, *b.o.*); "apical sclerite" absent, membranous lobe surrounding caudal part of *L2D* without discernible bristles or sclerites (Figs 67, 68). Sclerite *L3* (*L2d*) with distinct basal subsclerite (Figs 69, 70, *b.L3*), "folded structure" and bristles (Figs 69, 70, *f.s.*); groove *hge* present. Sclerite *L4U* (*L3d*) weakly sclerotized, triangular in shape.

Females: unknown.

Measurements (in mm): Head length 2.9, head width 2.9; pronotum length 3.8, pronotum width 5.5; tegmen length 15.5, tegmen width 5.0.

Comparison: *Gurneya rothi* sp. nov. shares the peculiar structure of armament of the anterior margin of the fore femora (*i.e.*, bimarginally serrated spines) with *G. obliqua* (Walker, 1869), the type and only known species of the genus, and *Alphelixia sicca* (Walker, 1869). The presence of bimarginally serrated spines readily differentiates these species from all other known epilamprines. The new species differs from *G. obliqua* in less expressed dark stripes on the pronotum (compare Fig. 60 and figs 33, 35 in Roth, 1974), the presence of apical spine on the anterior margin of fore femora and the truncated caudal margin of anal plate (compare Fig. 61 and fig. 38 in Roth, 1974). *Gurneya rothi*



Figs 59-70. *Gurneya rothi* sp. nov., male, holotype. (59) Facial part of head. (60) Pronotum, dorsal view. (61) Abdominal apex, dorsal view. (62) The same, ventral view. (63) Hypandrium, ventral view. (64) Right phallomere, dorsal view. (65) The same, ventral view. (66) Sclerite L2D, dorsal view. (67) Caudal part of sclerite L2D, seen from outside. (68) The same, dorsal view. (69, 70) Apex of sclerite L3. Dotted areas show dark colour (60) or membranous parts (62-70). Abbreviations: *b.L3*, *b.o.*, *c.p.R1T*, *f.s.*, *par.*, *r.scl.*, *R2*, *R3*, *R5* - see chapter "abbreviation used in figures", for details see text. Scale bars 1 mm: a = 59, b = 60, c = 61, d = 62, e = 63, f = 64, 65, g = 66, h = 67, 68, i = 69, 70.

sp. nov. differs from *A. sicca* in strongly expressed punctuation and the shape of anal plate (compare Fig. 61 and figs 5, 7 in Roth, 1973).

Genus *Pinaconota* Saussure, 1895

Type species: *Blatta bifasciata* Saussure, 1862, by monotypy.

Remarks: This genus was discussed in detail by Roth (1974).

Included species: The type species and *P. inaequalis* (Walker, 1868).

Pinaconota bifasciata (Saussure, 1862)

Figs 71-84

Blatta bifasciata Saussure, 1862: 165. – Saussure, 1864: 98.

Phyllodromia bifasciata. – Brunner von Wattenwyl, 1865: 94.

Blatta bifasciata. – Walker, 1868: 87.

Epilampra bifasciata. – Saussure, 1870: 84, pl. 2 fig. 44, 44A.

Pinaconota bifasciata. – Saussure, 1895: 337.

Epilampra bifasciata. – Kirby, 1904: 113.

Pinaconota bifasciata. – Shelford, 1910: 5. – Princis, 1958: 68.

– Princis, 1967: 655, 656. – Roth, 1973: 3, 4. – Roth, 1974: 290-295, figs 1-23.

Material: Lectotype; MHNG; male; Brazil, “474 8 Brésil. ♂ M’ Sorvel”, “*Epilampra bifasciata*, ♂ Sss.”, “Leetotypus *Blatta bifasciata* Sauss. ♂ K. Princis 1970”, “*Pinaconota bifasciata* (Sauss.)”, genital complex in prep. 100815/06.

Redescription of male (lectotype): The original description and description of Roth (1974) can be supplemented with the following details. Head (Fig. 71) and pronotum (Fig. 72) contrastingly coloured. Surfaces smooth and lustrous, only proximal third of tegmina with punctuation. Head about as long as wide (Fig. 71); ocellar spots indistinct; facial part flat; distance between eyes about as long as eye length; distance between antennal sockets about twice scape length (0.8 mm); approximate length ratio of 3rd-5th segments of maxillary palps 1.4 : 1.0 : 1.4. Pronotum as in Fig. 72. Tegmina and wings slightly abbreviated, reaching to abdominal apex. Tegmina with rounded apex; venation distinct; costal field triangular with obsolete venation; *Sc* thickened (well visible on ventral side of tegmen); *R*, *M* and *CuA* stems not separated basally; *CuP* distinct. Wings abbreviated and membranous. Fore tibiae not thickened distally. Anterior margin of fore femora armed type B, with 6 spines, including 1 apical one. Tibial spines well developed. Structure of hind tarsi: metatarsus about as long as or shorter than other tarsal segments combined (5th tarsal segments of hind tarsi broken off), with euplantula apical, about one fourth of metatarsus length; euplantulae of 2nd-4th segments large; metatarsus with 2 more or less equal

short rows of spines along lower margin; one pair of “additional spines” bordering euplantulae from inside and outside. Only pretarsus of right fore leg present; claws symmetrical and simple; arolium large, about one half of claw length. Abdomen without visible glandular specializations. Anal plate (tergite X) widely rounded, with medial incision (Figs 73, 74). Cerci short, with distinct segments (Figs 73, 74). Paraprocts of blaberid-type (Fig. 74). Hypandrium asymmetrical, caudally projected; styli cylindrical (Figs 75, 76).

Genitalia (Figs 76-84): Right phallomere (R+N): sclerite R1T with caudal part wide (Figs 77, 78, *c.p.R1T*); bristles present; R2 curved; R3 triangular, closely associated with R1T; R4 large, closely associated with small additional sclerite (Figs 77, 78, *a.R4*); R5 lobe-like, sclerotized apically. Sclerite L2D (L1) divided into basal and apical parts (Figs 76, 79, 80), widened cranially; “apical sclerite” present (Figs 76, 79, 80, *ap.scl.*), strongly sclerotized along caudal margin, densely covered with recumbent bristles and not numerous large spines (Figs 79, 80, *sp.*). Large rectangular sclerite situated under caudal part of L2D (Fig. 79, *scl.*); fourth “chaeta-bearing areas” with large spines and bristles situated under sclerite L2D (Fig. 79, *ch.a.*). Sclerite L3 (L2d) with distinct basal subsclerite (Fig. 81, *b.L3*), “folded structure” absent, but a few bristles present (Fig. 81); groove *hge* and finger-like basal projection well developed (Figs 82-84, *hge*, *b.pr.*); apex of L3 with small membranous lobe (Figs 82-84, *m.l.*). Sclerite L4U (L3d) weakly sclerotized (Fig. 76).

Measurements (in mm): Head length 3.2, head width 3.2; pronotum length 5.0, pronotum width 7.2; tegmen length 13.5, tegmen width 5.3.

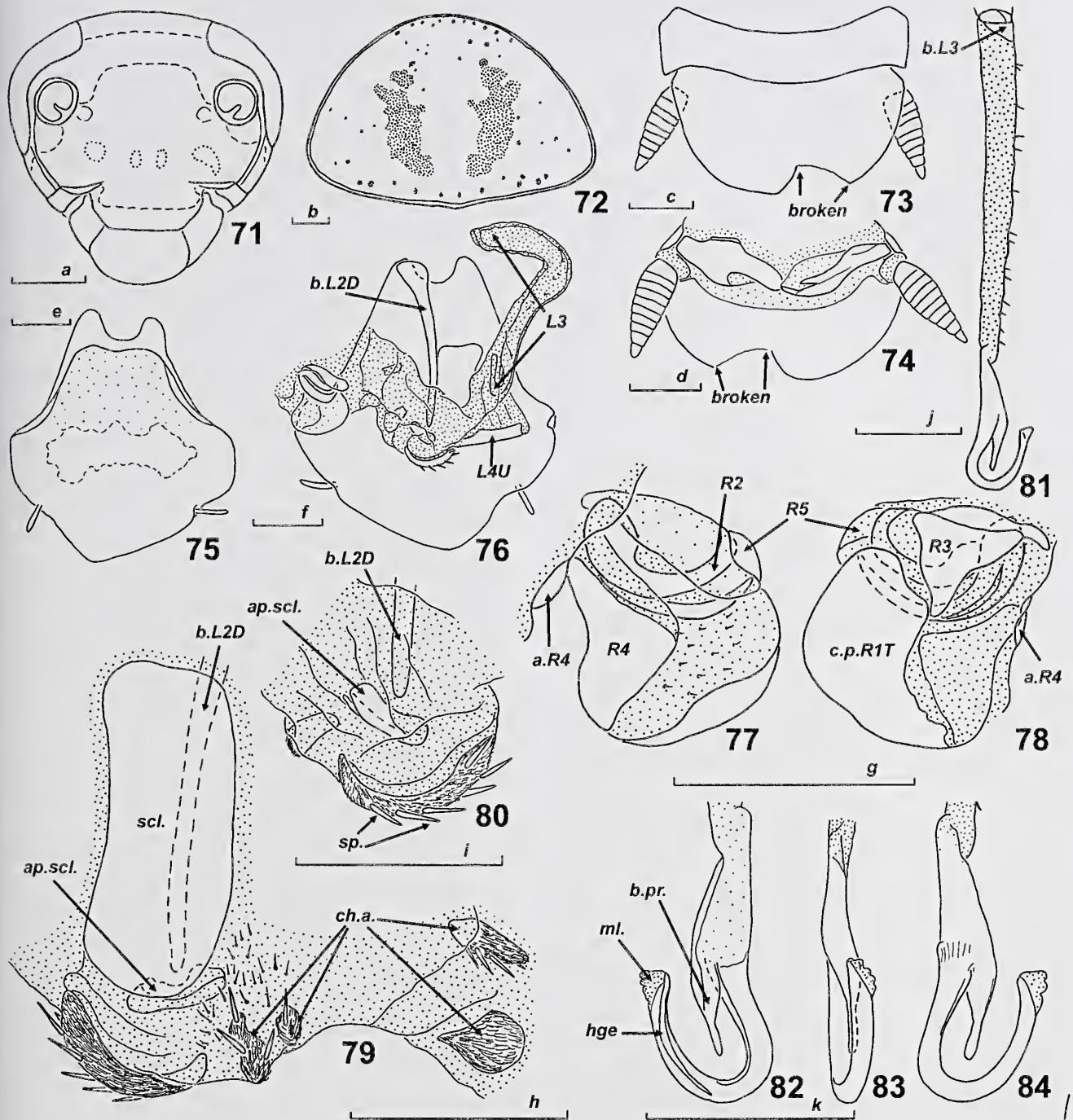
Note: Roth (1974) erroneously stated that Saussure’s type of *P. bifasciata* is female, but in fact it is male.

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The author is greatly indebted to Dr Peter Schwendinger (MHNG) for the possibility to study the Dictyoptera collections of the Muséum d’histoire naturelle de Genève and for his hospitality during my visits to Genève. The author thanks John Hollier (MHNG) for helpful comments and for improving the English. I also wish to thank the anonymous reviewer for improvements to the manuscript. This investigation was performed in the framework of the state research project No. 01201351189 (Russian Federation).

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Figs 71-84. *Pinaconota bifasciata* (Saussure, 1862), male, lectotype. (71) Facial part of head. (72) Pronotum, dorsal view. (73) Abdominal apex, dorsal view. (74) The same, ventral view. (75) Hypandrium, ventral view. (76) Hypandrium and genitalia, dorsal view. (77) Right phallomere, dorsal view. (78) The same, ventral view. (79) Caudal part of sclerite L2D and adjacent structures, ventral view. (80) Caudal part of sclerite L2D, dorsal view. (81) Sclerite L3. (82-84) Apex of sclerite L3. Dash lines show black maculae (71, 75). Dotted lines show yellowish maculae (71). Dotted areas show dark colour (72) or membranous parts (74-84). Abbreviations: *a.R4*, *ap.scl.*, *b.L2*, *b.L3*, *b.pr.*, *c.p.R1T*, *ch.a.*, *hge*, *L3*, *L4U*, *ml.*, *R2*, *R3*, *R4*, *R5*, *scl.* - see chapter "abbreviation used in figures", for details see text. Scale bars 1 mm: *a* = 71, *b* = 72, *c* = 73, *d* = 74, *e* = 75, *f* = 76, *g* = 77, 78, *h* = 79, *i* = 80, *j* = 81, *k* = 82-84.

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***Colilodion schulzi* sp. n. (Coleoptera: Staphylinidae: Pselaphinae) from Palawan, the Philippines, with habitus photographs and a revised key to all *Colilodion* species**

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Abstract: *Colilodion schulzi* sp. n. from Palawan, the Philippines, is described based on a female specimen. The new species possesses three-segmented antennae with conspicuously broadened apical antennomeres. Habitus images of the new and all previously described *Colilodion* species are provided. A revised key to the *Colilodion* species is included.

Keywords: Taxonomy - Clavigeritae - Colilodionini - new species - Oriental region.

INTRODUCTION

The genus *Colilodion* Besuchet, 1991 is the only member of the tribe Colilodionini. Currently seven species are known from southern China, central Vietnam, West and East Malaysia, and western Sumatra (Besuchet, 1991; Löbl, 1994, 1998; Nomura & Sugaya, 2007). As discussed in Löbl (1994), the group exhibits characters states found both in Clavigeritae (e.g. antennae three- to four-segmented, with enlarged apical antennomeres; strongly reduced maxillary palpi; fused abdominal tergites and fully-developed sternite III) and Pselaphitae (e.g. third tarsomeres longer than second; presence of free sternite IX in male), but none of these characters can be used as conclusive evidence to determine the phylogenetic position of *Colilodion*. Here we agree with Löbl, tentatively accepting the placement of *Colilodion* in Clavigeritae by Besuchet (1991), pending new evidence becomes available.

Recently we recognized an additional *Colilodion* species in the collection of the Muséum d'histoire naturelle de la Ville de Genève, represented by a single female specimen collected by Andreas Schulz (Leverkusen, Germany) on Palawan Island (Philippines). Unlike previously known congeners, it is distinctive in having the third antennomeres strongly broadened throughout their entire length, and a stout general habitus. In addition to a description of this new species, we also provide colorful habitus images of all eight species of this rare genus, and an updated identification key.

MATERIAL AND METHODS

All material treated in the present paper is deposited in the Muséum d'histoire naturelle de la Ville de Genève (MHNG).

The habitus image of each species was based on the respective type material, except for *Colilodion inopinatus*, where we chose an identified specimen in better condition. The habitus images were taken using a Canon 7D camera in conjunction with a Canon MP-E 65mm f/2.8 1-5X Macro Lens and a Canon MT-24EX Macro Twin Lite Flash. Images of the morphological details were made using a Canon G9 camera mounted on an Olympus CX31 microscope. Zerene Stacker (version 1.04) was used for image stacking. All images were modified and grouped in Adobe Photoshop CS5 Extended (version 12.0).

The label data of the material are quoted verbatim. A slash (/) is used for separation of different labels. The following abbreviations are applied: AL – length of the abdomen along the midline; AW – maximum width of the abdomen; EL – length of the elytra along the sutural line; EW – maximum width of the elytra; HL – length of the head from the anterior clypeal margin to the occipital constriction; HW – width of the head across eyes; PL – length of the pronotum along the midline; PW – maximum width of the pronotum. Length of the body is a combination of HL + PL + EL + AL.

TAXONOMY

Colilodion schulzi new species

Figs 1A, 3

Holotype: ♀, labeled 'PAL-09/08: PHILIPPINES: Palawan, Puerto Princesa Region, Sabang, Mt. Bloomfield, 10°11'37"N, 118°52'21"E, 500-700 m, primary forest, 10.XII.2009, leg. A. Schulz. PAL-09/08 (printed) / MHNG ENTO 00008847 (accession number) (printed) / Holotype ♀, *Colilodion schulzi* sp. n., det. Yin & Cuccodoro, 2015 (hand written)'.

Differential diagnosis: *Colilodion schulzi* shares with *C. concinnus* Besuchet and *C. inopinatus* Besuchet the broadened antennomeres III with the impressed dorsal surface indicated by divided smooth fields. It can be readily separated from these two species by the antennomeres III being strongly broadened throughout their entire length, with a slightly narrowed base, a stouter pronotum with coarser discal punctation, and a relatively much broader elytral base. Both *C. concinnus* and *C. inopinatus* have the antennomeres III much narrower at the base than at the apex, their pronota are less stout, the discal punctation is finer, and the elytral base is relatively much narrower.

Description: Length 2.37 mm. Body and appendages reddish brown (Fig. 1A). Pubescence of body short and recumbent.

Head longer than wide, HL 0.43 mm, HW 0.34 mm. Vertex (Fig. 3A) strongly raised dorsally, narrowed apically, surface of raised area densely and roughly punctate, lateral area (Fig. 3B) vertical, very finely punctate, dorsal margin convex in lateral view, situated slightly below level of pronotum, bearing thick, posteriorly-oriented dorsolateral and dorsomedian trichomes; posterior edge of vertex narrowed to become keel-like below, bearing two fairly long, diverging trichomes oriented posteriorly. Frons sparsely but roughly punctate, pubescence fine. Each eye composed of about 22 facets, unevenly divided by thick lateral ocular carina (Fig. 3B), dorsal part with about 20 facets, ventral part with 2 facets. Gular ridge (Fig. 3C) broad, thickened at middle, anterolateral surface sparsely and roughly punctate, with short pubescence. Occipital constriction impunctate, shiny, vertical at ventral margin.

Antennae (Fig. 3D) three-segmented; antennomere I visible in dorsal view, slightly transverse, roughly punctate on ventral surface, with short, thick setae; antennomere II distinctly transverse, wider and shorter than antennomere I, surface roughly punctate, with short setae; antennomere III 0.92 mm long, 0.39 mm wide, strongly broadened throughout length, impressed dorsal surface indicated by divided smooth fields, sparsely covered with short setae; setae of anterior margin longer and thicker; apical sensilla with raised margin, with two short setae.

Pronotum trapezoidal, PL 0.63 mm, PW 0.53 mm (at base), gradually narrowed apically; apical portion (Fig. 3A)

broadly notched, notch deeper at middle; median groove evenly narrow, sharply delimited, extending posteriorly near pronotal base and anteriorly to posterior edge of apical notch; sub-antrolateral areas broadly concave; dorsum extremely coarsely punctate, distinctly margined laterally at anterior third, sub-basal area smooth; lateral surface (Fig. 3B) extremely finely punctate and with fine setae; posterolateral angles distinct, posterior margin smoothly sinuate; anterolateral edges slightly oblique, each bearing conspicuous trichome forming rim oriented dorso-anteriorly and pointed dorsally; dorsal anterior edge with shorter and thinner trichomes oriented anteriorly and curved dorsally near tip.

Elytra (Fig. 3E) wider than long, EL 0.73 mm, EW 0.95 mm; elytral disc flattened, slightly raised, sparsely covered with coarse punctation, densely microsculptured, with short, recumbent setae; each elytron with seven longitudinal striae, sutural and pair of inner striae complete, pair of central striae with inner stria extending from base to half of elytral length, and outer one much fainter, pair of outer striae with inner stria complete, outer one extending from basal third to posterior margin; anterolateral margin round, area nearby finely punctate and lacking microsculpture, punctation and setae of lateral area similar to those of disc, interval between punctures smooth, lacking microsculpture; posterior area with row of sparse, long, and thick setae, with bunch of thick setae at posterolateral margin.

Prosternum (Fig. 3C) with triangular process rising from anterior margin, and large vertical process rising from posterior margin; median area with several setae, lacking obvious trichome, lateral surface of process distinctly microsculptured. Anterior mesoventral edge (Fig. 3F) slightly raised, pointed at middle, lateral areas with big and shallow punctures, inner sides with microsculpture. Metaventrite (Fig. 3F) raised at middle, anterior half and lateral area of basal half with shallow, large punctures and short setae.

Abdomen transverse, AL 0.58 mm, AW 0.89 mm; first visible tergite (Fig. 3G) broadly and deeply impressed between elongate basolateral ridges, with dense setae along posterior margin of impression; disc finely punctate and lacking microsculpture at basal half, with shallow, large punctures and microsculptured interval at apical half, pubescence mostly fine, with two rows of thick, erect setae at apical portion, with truncate apex; paratergites well-demarcated, with few long, erect setae; second tergite with row of long, erect apical setae, with distinct lateral tubercles. First visible sternite (morphologically sternite III) (Fig. 3H) with coarse punctation and dense microsculpture, setae fine; second sternite long, punctation and microsculpture much more denser at middle than at lateral portion; following sternites similarly microsculptured and with short setae. Tibiae (Figs 3I-K) distinctly sculptured, narrowed at basal third, apical two-thirds abruptly thickened, bearing conspicuous rows of erect setae on dorsal side.



Fig. 1. Dorsal habitus of *Colilodion* species. (A) *C. schulzi*. (B) *C. concinnus*. (C) *C. incredibilis*. (D) *C. inopinatus*. Scales: 0.5 mm.



Fig. 2. Dorsal habitus of *Colilodion* species. (A) *C. mirus*. (B) *C. tetramerus*. (C) *C. thienmu*. (D) *C. wuesti*. Scales: 0.5 mm.

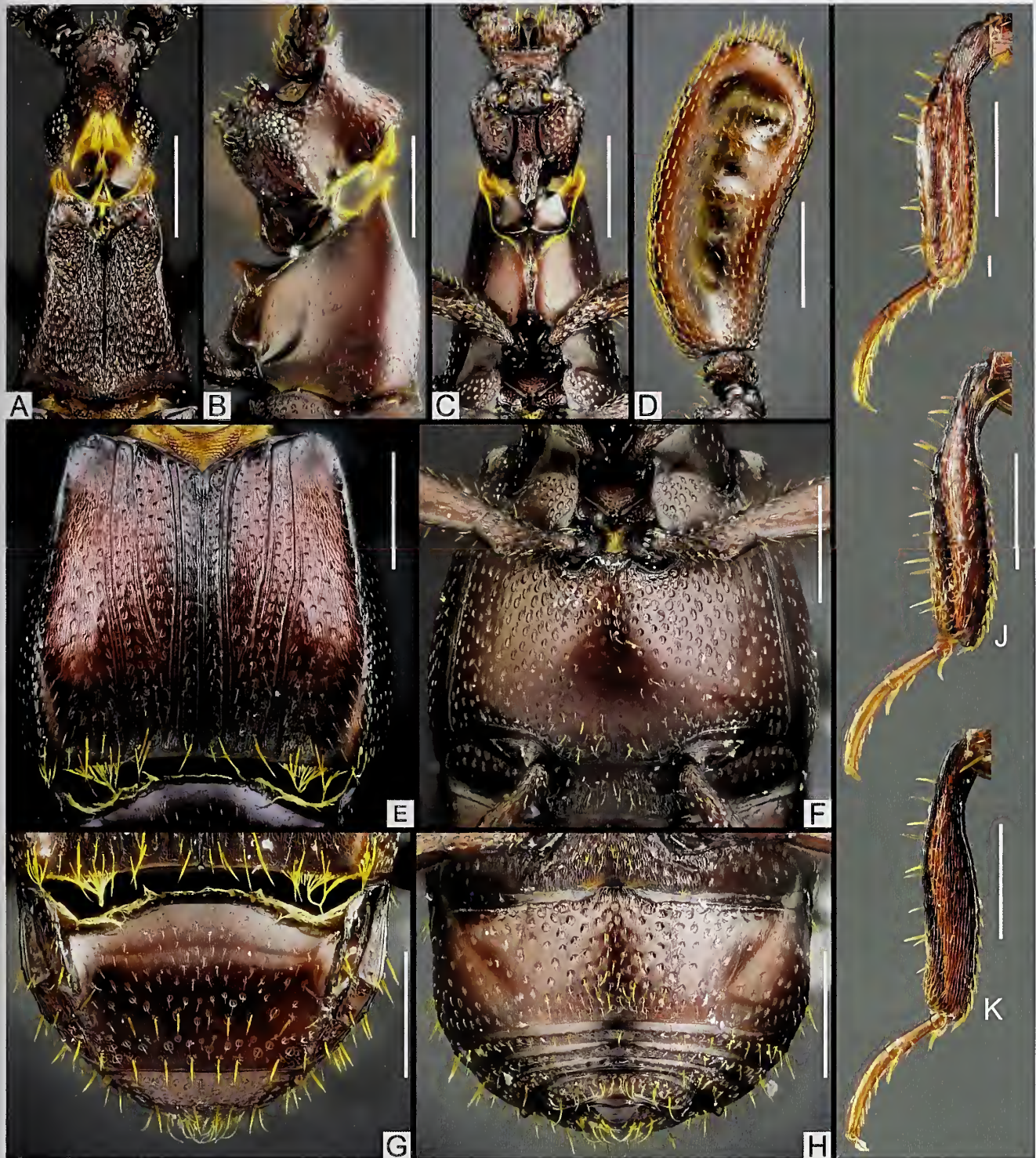


Fig. 3. Morphological details of *Colilodion schulzi*. (A) Head dorsum and pronotum. (B) Head and pronotum, in lateral view. (C) Head venter and prosternum. (D) Right antenna. (E) Elytra. (F) Meso- and metaventrite. (G) Abdominal tergites. (H) Abdominal sternites. (I) Protibia. (J) Mesotibia. (K) Metatibia. Scales: A-H = 0.3 mm; I-K = 0.2 mm.

Key to *Colilodion* species (modified from Löbl, 1994) (Figs 1-3)

| | | |
|---|---|---|
| 1 | Antenna four-segmented..... | 2 |
| - | Antenna three-segmented | 3 |
| 2 | Antennomere IV evenly curved laterally throughout whole length (Fig. 2B); body size smaller, 2.15 mm. (southern China: Hainan) | <i>C. tetramerus</i> Löbl, 1998 |
| - | Antennomere IV markedly curved laterally at basal one-fifth (Fig. 2C); body size larger, 2.54 mm. (central Vietnam: Thua Thien Hue) | <i>C. thienmu</i> Nomura & Sugaya, 2007 |
| 3 | Antennomere III strongly broadened, with impressed dorsal surface indicated by divided smooth fields | 4 |
| - | Antennomere III subcylindrical or dorsally flattened, lacking impressed fields | 6 |
| 4 | Antennomere III broadened throughout whole length, base slightly narrowed (Figs 1A, 3D); posterior margin of elytra with long, thick golden setae (Fig. 3E). (Philippines: Palawan) | <i>C. schulzi</i> , new species |
| - | Antennomere III much more narrowed at base than at apex (Figs 1B, 1D); posterior margin of elytra lacking long, thick setae | 5 |
| 5 | Punctuation of tergite IV distinct, similar to that of elytra and pronotum (Fig. 1B). (Indonesia: western Sumatra) .. | <i>C. concinnus</i> Besuchet, 1991 |
| - | Punctuation of tergite IV obsolete, much finer than that of elytra and pronotum (Fig. 1D). (East Malaysia: Sabah) | <i>C. inopinatus</i> Besuchet, 1991 |
| 6 | Antennomere III flattened dorsally (Fig. 2D); elytral marginal carina short, disappear before reaching mid-length of elytron. (West Malaysia: Pahang) | <i>C. wuesti</i> Löbl, 1994 |
| - | Antennomere III subcylindrical (Figs 1C, 2A); elytral marginal carina extended posteriorly beyond mid-length of elytron | 7 |
| 7 | Antennomere III barely curved, shorter than half of body length (Fig. 1C). (East Malaysia: Sabah) | <i>C. incredibilis</i> Besuchet, 1991 |
| - | Antennomere III distinctly curved, longer than half of body length (Fig. 2A). (East Malaysia: Sabah) | <i>C. mirus</i> Besuchet, 1991 |

Biology: The single female was collected from a sample of sifted vegetable debris in a sparse coniferous forest that was subsequently processed using Winkler-Moczarski electors. The locality is a quite dry and hot place on a hilltop with lots of stones on the ground. The most common ant genera in that area were *Camponotus*, *Paratrechina*, and some other myrmecine genera (A. Schulz pers. comm.).

Distribution: The new species is known only from the type locality.

Etymology: The specific epithet is dedicated to Andreas Schulz, who collected the holotype.

ACKNOWLEDGMENTS

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Contribution to the knowledge of Himalayan and North Indian species of *Scaphidium*
(Coleoptera, Staphylinidae)

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Abstract. *Scaphidium solukhumbu* sp. nov. and *S. yeti* sp. nov. are described from Eastern Nepal. *Scaphidium* sp. possibly representing an undescribed species is reported from Chitwan National Park, Nepal. Published records of *Scaphidium quadrimaculatum* Olivier from India are considered to be based on misidentifications.

Keywords: Coleoptera - Staphylinidae - Scaphidiinae - taxonomy - Himalaya - India.

INTRODUCTION

The genus *Scaphidium* Olivier, 1790 with its 340 species is known from almost all major biogeographic regions and exhibits its highest diversity in the subtropics and tropics (Löbl, 1997 and subsequent papers). The number of species decreases in areas with temperate or cool climate, and consequently at higher elevations. Currently, only the following Himalayan species have been reported from altitudes above 2000 m (Löbl, 1992; 2005): *S. arrowi* Achard, 1920, *S. melanogaster* Löbl, 1992, *S. harmandi* Achard, 1920, *S. rubritarse* Pic, 1915, *S. biundulatum* Champion, 1927, *S. gurung* Löbl, 1992, *S. nepalense* Löbl, 1992, and *S. thakali* Löbl, 1992, the last four have been reported only from altitudes above 2000 m. Two additional species of *Scaphidium* from comparatively high altitudes in Nepal Himalaya were found within newly examined collections and they are described in the present paper. A further Nepalese species of *Scaphidium* is also recorded here but left unnamed. It is represented by a single female specimen that possibly belongs to a new species but which at this stage cannot be adequately defined. Finally, the records of *Scaphidium quadrimaculatum* Olivier, 1790 (Chandra & Shivaramakrishnan, 1986) from northern India are discussed.

MATERIAL AND METHODS

The material examined is housed in the Staatliches Museum für Naturkunde, Stuttgart, Germany (SMNS), Naturkundemuseum, Erfurt, Germany (NMEC) and

Muséum d'histoire naturelle, Geneva, Switzerland (MHNG).

The specimen data are reproduced verbatim as on the respective labels. The body length is measured from anterior pronotal margin to inner apical angle of elytra unless stated differently. The habitus images were taken by a single-lens reflex camera (CANON® EOS Kiss X7) with a macro photo lens (CANON® MP-E 65 mm Macro lens) attached to the stand (LPL® CSC-10), and then focus-stack images were created with Combine ZM.

TAXONOMY

Scaphidium solukhumbu sp. n.

Figs 1, 3, 4

Holotype: SMNS; ♂; 514 NEPAL: Solukhumbu Distr., Junbesi 2700 m, 11.V.1997 leg. M. Hauser.

Paratypes: SMNS, MHNG; 2 ♀; 521 NEPAL: Solukhumbu Distr., below Pangun 2500 m, 14.-15.V.1997 leg. W. Schawaller. – MHNG; 1 ♀; 525 NEPAL: Solukhumbu Distr., Hinku Drangka Khola bridge 2000, 18-19.V.1997, leg. W. Schawaller.

Etymology: The species epithet is the name of the district in Eastern Nepal in which the species was collected.

Description: Length 4.0-4.4 mm (with head and abdomen about 5.1 mm); width 2.8-2.95 mm. Body black, elytra each with subbasal and subapical transverse reddish fasciae, both narrowed in middle, reaching to lateral margin striae. Subbasal fascia almost



Figs 1-2. *Scaphidium solukhumbu* sp. n., female paratype, in dorsal and lateral views (1), *Scaphidium yeti* sp. n., holotype (2), in dorsal and lateral views. Scale bar = 1 mm, valid for both species.

reaching sutural stria and basal puncture row, larger than subapical fascia and strongly narrowed in middle (Fig. 1). Mouthparts brown to reddish. Antennomeres I to VII dark brown to reddish, VIII to X black, XI black in basal half to two thirds, brown in apical half to third. Femora and tibiae black, tarsi dark brown. Frons wide, at narrowest point 0.22-0.27 mm, with punctures smaller than puncture intervals, becoming dense posterior level of eyes. Pronotum not elevated above level of elytra, gradually, moderately inflexed anteriorly; lateral margins slightly sinuate, anterior section of lateral margin striae not exposed in dorsal view. Prevailing pronotal punctation fine, most puncture intervals about as twice as large as diameters in middle part of disc, punctures very fine at base, antebasal puncture row slightly impressed, not interrupted in middle. Anterior and lateral margin striae impunctate. Scutellum convex. Elytra moderately convex, without impressions or protuberances; adsutural areas flat in basal third, raised in apical two thirds; discal punctation finer and less dense than pronotal punctation; discal puncture rows absent; sutural striae with punctures about as small as discal punctures. Hypomera and mesanepisterna shiny, not microsculptured, very finely punctate. Prosternal margin punctures not elongate. Middle part of metaventrite impressed posterior mid-length, with discal uninterrupted. Metacoxal process of metaventrite truncate, not notched. Legs fairly long. Abdomen finely punctate, with punctulate microsculpture.

Male characters: Metaventrite with deep mesal impression. Setal patch dense, covering impressed two thirds of mesal part of metaventrite, setae recumbent and moderately long, except for longer lateral setae, latter oblique, weakly eurred. Setiferous punctures dense and coarse, puncture diameters about as puncture intervals. Anterior side of profemora with elongate carina. Protibiae slightly sinuate, thickened posterior mid-length, about 0.11 mm at widest point, near base about 0.08 mm. Protarsomeres 1 to 3 moderately widened. Mesotibiae slightly bent, somewhat thickened in apical third, with distinct setal comb on inner side. Metatibiae almost straight, slightly thickened apically. Aedeagus (Figs 3, 4) 1.42 mm long.

Female characters: Tibiae slightly shorter than in male. Protibiae straight, apical third of mesotibiae and metatibiae slightly bent. Metaventrite with shallow apicomedian impression; punctation much finer than that on middle of sternite 1. Gonocoxite densely setose along inner margin, with two long and one short subapical setae near our apical angle. Gonostyle short, narrowed apically, with one short, one fairly long and one long apical setae, in addition to few scattered setae.

Type locality: Nepal, Solukhumbu District, Junbesi, 2700 m.

Comments: This species is similar to *S. nepalense* from

which it may be readily distinguished by the narrower frons, the pronotum with barely sinuate lateral margins and finer punctation, the shape of the elytral fasciae, in males by the less curved mesotibiae and metatibiae, the patch on metaventrite consisting mostly of straight, recumbent setae, the shape of the median lobe and the internal sac of the aedeagus, in particular by the oblique ventral side of the median lobe (in lateral view) and by the shape of sclerites of the internal sac. As the median lobes of the aedeagi are in these two species more distinctive in lateral than in dorsal view, an illustration of the aedeagus of *S. nepalense* in lateral view is here given (Fig. 5). The internal sac of the aedeagus of *S. solukhumbu* is similar to that in *S. harmandi* (see Löbl, 1992: 593, fig. 72); these two species may be easily distinguished by the head colour and the secondary male characters.

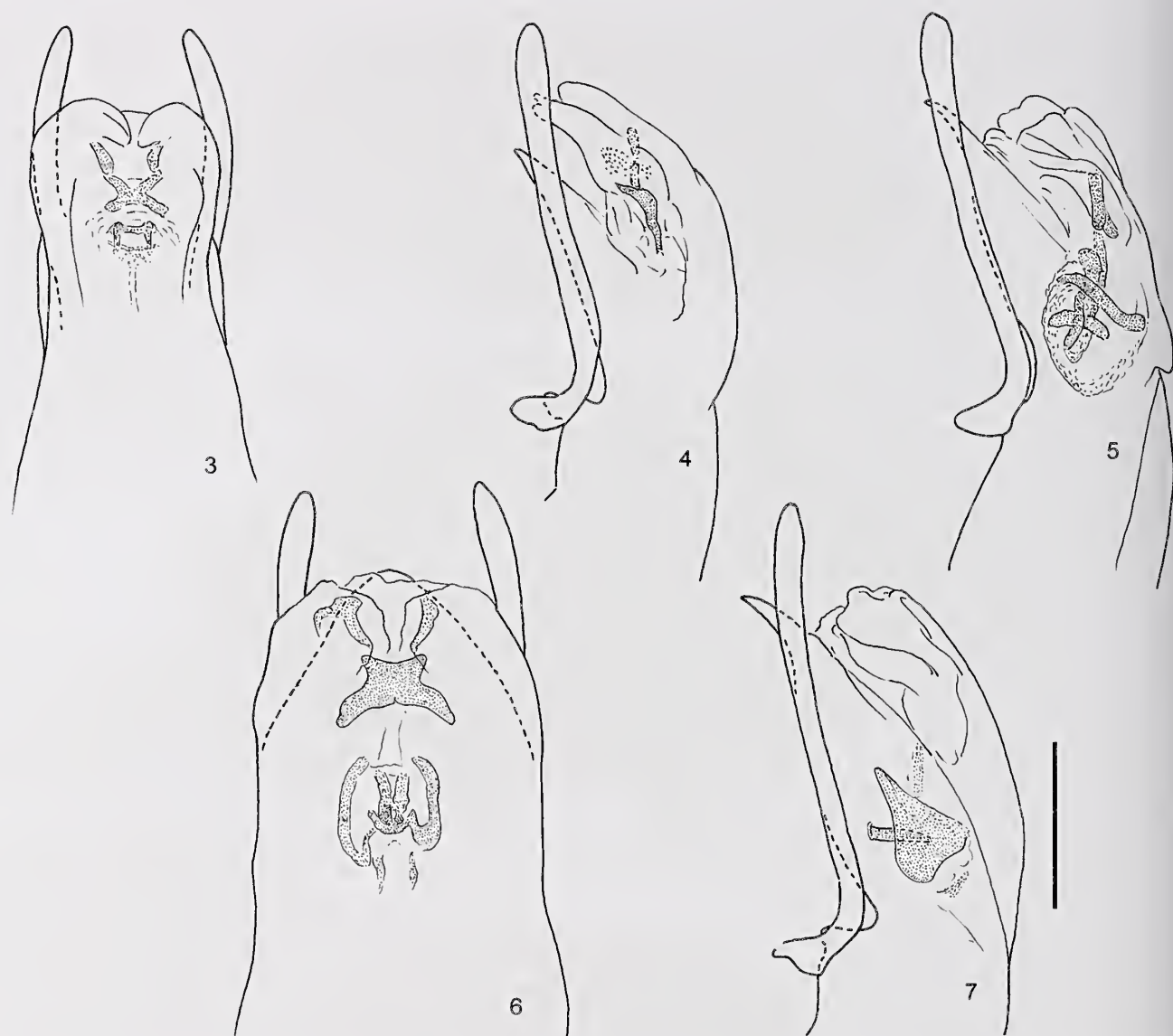
Scaphidium yeti sp. n.

Figs 2, 6, 7

Holotype: NMEC; ♂; NEPAL Rolwaling Himal upp. Simigau vill. 2600 m 2.6.2000 leg. Schmidt.

Etymology: The species epithet is the name of the mysterious Yeti reputed to occur in the Rolwaling Valley.

Description: Length 5.4 mm (with head and abdomen about 6.5 mm), width 3.7 mm. Body black, elytra each with subbasal and subapical transverse, irregular and well delimited reddish fasciae, both not or slightly narrowed in middle and reaching to lateral margin striae. Subbasal fascia barely extended onto inner half of elytra, much larger than subapical fascia (Fig. 2). Mouthparts brown. Antennomeres I to VII dark brown, VIII to XI black. Femora and tibiae black, tarsi dark brown. Frons wide, at narrowest point 0.42 mm, punctures irregular, mostly much smaller than puncture intervals, becoming dense posterior level of eyes. Pronotum not elevated above level of elytra, gradually inflexed anteriorly; lateral margins distinctly sinuate, entirely visible in dorsal view. Prevailing pronotal punctation fine, with most puncture intervals about as large to twice as large as puncture diameters on middle part of disc, punctures very fine at base, antebasal puncture row slightly impressed, not interrupted in middle. Anterior margin stria impunctate, lateral margin striae irregularly punctate. Scutellum almost flat. Elytra moderately convex, adsutural areas flat in basal third, raised in apical two thirds, without impressions or protuberances; discal punctation finer than and about as dense as pronotal punctation; discal puncture rows absent; sutural striae with punctures about as small as discal punctures. Hypomera and mesanepisterna shiny, not microsculptured, very finely punctate. Prosternal margin punctures not elongate.



Figs 3-7. *Scaphidium solukhumbu* sp. n., holotype, aedeagus in dorsal (3) and lateral (4) views. *Scaphidium nepalense* Löbl, aedeagus in lateral view (5). *Scaphidium yeti* sp. n., holotype, aedeagus in dorsal (6) and lateral (7) views. Aedeagi without proximal part of basal bulb. Scale bar = 0.3 mm, valid for both species.

Middle part of metaventricle impressed posterior mid-length, with discrimen fine, uninterrupted. Metacoxal process of metaventricle truncate, not notched. Legs fairly long. Abdomen finely punctate, with punctulate microsculpture.

Male characters: Metasternum with shallow mesal impression. Setal patch dense, covering posterior half of median part of metaventricle, extending apicolaterally to level of trochanters, setae recumbent and short in middle, long, raised and curled anterior of and inbetween metacoxae, forming mesal comb. Setiferous punctures dense and coarse, puncture diameters mostly larger than puncture intervals. Anterior side of profemora angulate. Protibiae slightly sinuate, thickened posterior basal third, about 0.20 mm at widest point, near base about 0.12 mm

wide. Mesotibiae slightly curved, gradually thickened toward apices, each with distinct setal comb on inner side. Metatibiae slightly curved and thickened apically. Aedeagus 1.57 mm long (Figs 6-7).

Female characters: Unknown.

Type locality: Nepal, Dolakha District, Rolwaling Himal, upper Simigau village, 2600 m.

Comments: This species is very similar to *S. nepalense*. It differs by the colour pattern of the elytra and the male sexual characters. Notable are in the new species the thicker tibiae, the metaventricle with long curled setae forming a ridge-like mesal comb, the apical part of the parameres barely widened in lateral view, and the distinctive shape of the sclerites of the internal sac.

Scaphidium sp.

Material examined: SMNS; 1 ♀, 548 NEPAL: Chitwan Distr. Chitwan N.P.: Sauraha 150 m, 31.V.-1.VI.1997 leg. W. Schawaller.

Comments: This species is likely new but available in a single, damaged female while usually males possess the more important diagnostic characters. It is characterized by: Body 4.0 mm long (with head and abdomen 4.65 mm), 2.24 mm wide, black, without metallic shine, with weakly convex lateral contours. Femora and tibiae almost as dark as body. Antennomeres I to VI, mouthparts, tarsi and apex of abdomen lighter, dark reddish-brown to ochreous. Pronotal punctation dense and fairly coarse, with punctures much smaller than puncture intervals, similar to elytral punctures. Hypomera smooth. Metaventricle with indistinct punctation (80x magnification), with apicomedian part flattened. Discrimen throughout very narrow. Legs short, tibiae slightly bent.

This species is similar to *S. punctaticolle* Pic, 1923 from Vietnam. It may be readily distinguished by the darker legs and the anterior section of the discrimen evenly narrow and shallow. Other similar Asian species are *S. comes* Löbl, 1968, *S. incisum* Lewis, 1893 and *S. obtabile* (Lewis, 1893), all differing by the coarser pronotal punctation, *S. obtabile* also by a rugose upper part of hypomera.

Scaphidium quadrimaculatum Olivier, 1790

Comments: This well known species, with a range extending from Great Britain to Siberia and Altai (Löbl, 1997), is not mentioned from the Indian subcontinent in Löbl (1992, 2005). It was reported and redescribed from the Sub-Himalayan areas of Uttarakhand (former part of Uttar Pradesh) and Assam by Chandra & Shivaramakrishnan (1986). Their redescription lacks useful species specific characters, and the illustrated colour pattern does not fit that mentioned in the text. Thus, the specimens illustrated and used for the description in words were possibly not conspecific, and their identity remains unknown.

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Observations on two large athecate hydroids (Cnidaria: Hydrozoa)
from the Kamchatka Peninsula (NW Pacific)

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Abstract

This study reports on several specimens of two large hydroids from the North-Western Pacific Ocean: *Monocoryne bracteata* and *Candelabrum phrygium*. Both species are documented with photographs of the living animals as well as with photographs of the nematocysts and histological sections of the sporosacs. Both are rare animals and only known from a few specimens, which makes it difficult to assess their intraspecific variation. The new material differs in some minor details from previously known material and the significance of this is discussed here. It is concluded that these differences likely represent intraspecific variation. A re-examination of type material of *Candelabrum verrucosum* Bonnevie, 1898 added to knowledge of this nominal species and provided evidence that it is conspecific with *C. phrygium*. The diagnostic feature “nematocyst buttons on the sporosacs” of *C. verrucosum* occurs also in otherwise typical *C. phrygium* identified by other authors.

Keywords: Anthoathecata - Aplanulata - Capitata - systematics - biology - *in situ* observations - 16S sequence.

INTRODUCTION

Although ubiquitous in the marine environment, most hydroid polyps are small to microscopic. As a result, they tend to be noticed in the field only when colonies are formed. Nevertheless, a few hydroid polyps can grow to large sizes, with *Branchiocerianthus imperator* (Allman, 1885) reaching 1 metre or more (Schuchert, 2010), or *Candelabrum penola* reaching 85 cm in height (Manton, 1940). Other more common macroscopic hydroids include members of the families Tubulariidae and Corymorphidae. Because solitary macroscopic hydroid polyps are seen infrequently, two of us (N.S. and K.S.) were immediately aware of their uniqueness when we discovered two different species of conspicuous polyps while diving in waters of the Kamchatka Peninsula (NW Pacific Ocean). Their size and considerable numbers made it possible for us to take *in situ* photographs and to collect them individually for more detailed examination. The two species clearly belonged to the genera *Monocoryne* and *Candelabrum*. However, identification of them to species rank was difficult, and our taxonomic investigations and comparisons are presented in this work. For both genera, the extent of intraspecific morphological variation is difficult to assess due to the

current paucity of information. Only the accumulation of data through published studies on different populations will enable us to acquire a clearer idea of the intra- and interspecific variation of these animals. *Monocoryne* in particular is a rare, poorly-known genus, and more detailed information about its species is desirable. Except for *C. cocksii*, all other species of *Candelabrum* are also rare and few records of them exist.

MATERIAL AND METHODS

Hydroids studied here were observed, photographed and collected using SCUBA. Material for museum collections were preserved initially in 4% formaldehyde and subsequently transferred to 70% ethanol. Specimens for DNA extraction were preserved in absolute ethanol. For morphological examination techniques and terms see Schuchert (2012). Histological serial sections were made using standard paraffin embedding procedures, followed by haematoxylin and eosin staining. Nematocyst examinations and identifications were done using pieces of material preserved in absolute ethanol examined either in water or 50% lactic acid.

DNA extraction and sequencing of part of the 16S

mitochondrial RNA gene were done as described in Schuchert (2005; 2014). The DNA samples are in the DNA collection of the MHNG.

Photographs of type specimens of *Monocoryne bracteata* were provided by Dr Allen Collins (National Museum of Natural History, Washington), and those of the holotype of *C. serpentarii* were provided by Dr A. Andouche (Muséum National d'Histoire Naturelle, Paris).

Loans of specimens were provided by ROMIZ, ZMUC, and UZMO (see under material examined).

Museum acronym abbreviations:

MHNG Muséum d'histoire naturelle, Genève, Switzerland

ROMIZ Royal Ontario Museum, Invertebrate Zoology, Canada

UZMO Zoological Museum of the University of Oslo, Norway

ZIRAS Zoological Institute of the Russian Academy of Sciences

ZMUC Zoological Museum of the University of Copenhagen, Denmark

TAXONOMY

Monocoryne bracteata (Fraser, 1943)

Figs 1-3

Symplectanea bracteata Fraser, 1943: 78, pl. 13 fig. 1.

Monocoryne bracteata. – Rees, 1958: 17, fig. a-b. – in part Stepanjants *et al.*, 2003: figs 2A & 2C. – Brinckmann-Voss & Lindner, 2008: 1634, fig. 2A-B.

Material examined:

MHNG-INVE-92014, field number Kam05; 15 specimens in ethanol (males and females) and serial histological sections of middle region of males and females; Russia, Kamchatka Peninsula, Avacha Bay, Starichkov Island, 52.7823°N 158.61575°E, 16 m depth, temperature 2°C; collection date 18.06.2014; DNA extracted from 2 specimens preserved in ethanol, DNA isolates 1123 and 1124 gave both the same 16 sequence LN898142.

MHNG-INVE-92015, field number Kam06; 1 male and 1 female specimen in ethanol; Russia, Kamchatka Peninsula, Starichkov Island, 52.77915°N 158.61268°E, 7 m depth, temperature 10 °C; collection date 24.06.2009.

MHNG-INVE-92016, field number Kam07; 9 specimens in ethanol, males and females; Russia, Kamchatka Peninsula, Starichkov Island, 52.7796°N 158.6111°E, 10 m depth, temperature 5°C; collection date 17.07.2009; DNA extracted from 2 specimens preserved in ethanol, DNA isolates 1125 and 1126 gave both the same 16S sequence LN898143.

ZIRAS; several specimens in ethanol, one with branched polyp body; Russia, Kamchatka Peninsula, Avacha Bay, Starichkov Island, on pebbles, 52.7790°N, 158.6124°E, 8 m depth, temperature 4°C; collection date 02.06.2011.

ROMIZ B3646, 1 fragmented specimen with female sporosacs in ethanol; Russia, Okhotsk Sea, Urup Island, 46°N 149°E, 300 m depth; collection date 07.08.1987; elongate sporosacs with 0-20 egg like bodies.

Type locality: Albatross Station 4253; 57.67194°N 133.67944°W, Thistle Ledge, Stephens Pass, south-eastern Alaska, water depth 240-344 m (Brinckmann-Voss & Lindner, 2008).

Diagnosis: Solitary species of *Monocoryne*, with or without anchoring filaments, up to 200 widely spaced tentacle-groups comprising 3-10 tentacles (mostly around 6), tentacles grouped in linear arrays. Individuals gonochoristic, gonophores developing in upper axis of tentacle-groups, occurring as sporosacs without canal systems, elongate when fully mature, up to 3-4 times as long as wide, mature females with 3-20 maturing oocytes.

Description of Kamchatka material:

Morphology: Hydroid polyps solitary, vermiform, able to contract to 1/10 of length, not gregarious, subdivided into a basal, tentacle-free foot and an upper, tentacle-bearing part. Foot conical, length about 1/6 or less of total height when expanded, up to 1/3 when contracted or preserved, sheathed in an adhering, very thin, filmy perisarc, hardly visible in living animals, loose and wrinkled in preserved specimens. Basal tip of perisarc attached directly to substrate (small stones, shell debris); anchoring filaments absent. Tentacle-bearing zone thin, vermiform, squirming, beset with widely spaced groups of tentacles (in relaxed body). Tentacles capitate, somewhat contractile, up to 200 or more, in groups of 3-10 (mostly around 6), those of a cluster in a single row with bases fused through a common epidermis (Fig. 2G), rows of tentacles oriented transversely or obliquely to polyp axis. Terminal knobs (capitula) of tentacles spherical, about twice diameter of stalk; tentacle stalks relatively long and thin when extended. Terminal region of polyp with small, shallow hypostome surrounded by solitary tentacles.

Gonophores sporosacs developing singly in upper axils of tentacle-groups, usually confined to lower half of tentacle-bearing part. Sporosacs with distinct spadix, without radial canals or other vestiges of medusa stage (Fig. 2E-F). Young sporosacs spherical, later becoming elongated, contractile. Fully developed, relaxed male sporosacs oblong, about three times as long as thick (Fig. 2B). Female sporosacs spherical to spindle shaped when mature (Fig. 2C-D), containing 1-4 white, egg-like bodies (mature oocytes or clusters of developing oocytes and their nourishing cells). Individual polyps apparently either male or female, never hermaphroditic.



Fig. 1. *Monocoryne bracteata*, living animals, all Kam07. (A) Whole, expanded polyp, size about 3-4 cm. (B) Fully contracted polyp. (C) Tentacles, note clustering in linear arrays and fusion of bases.

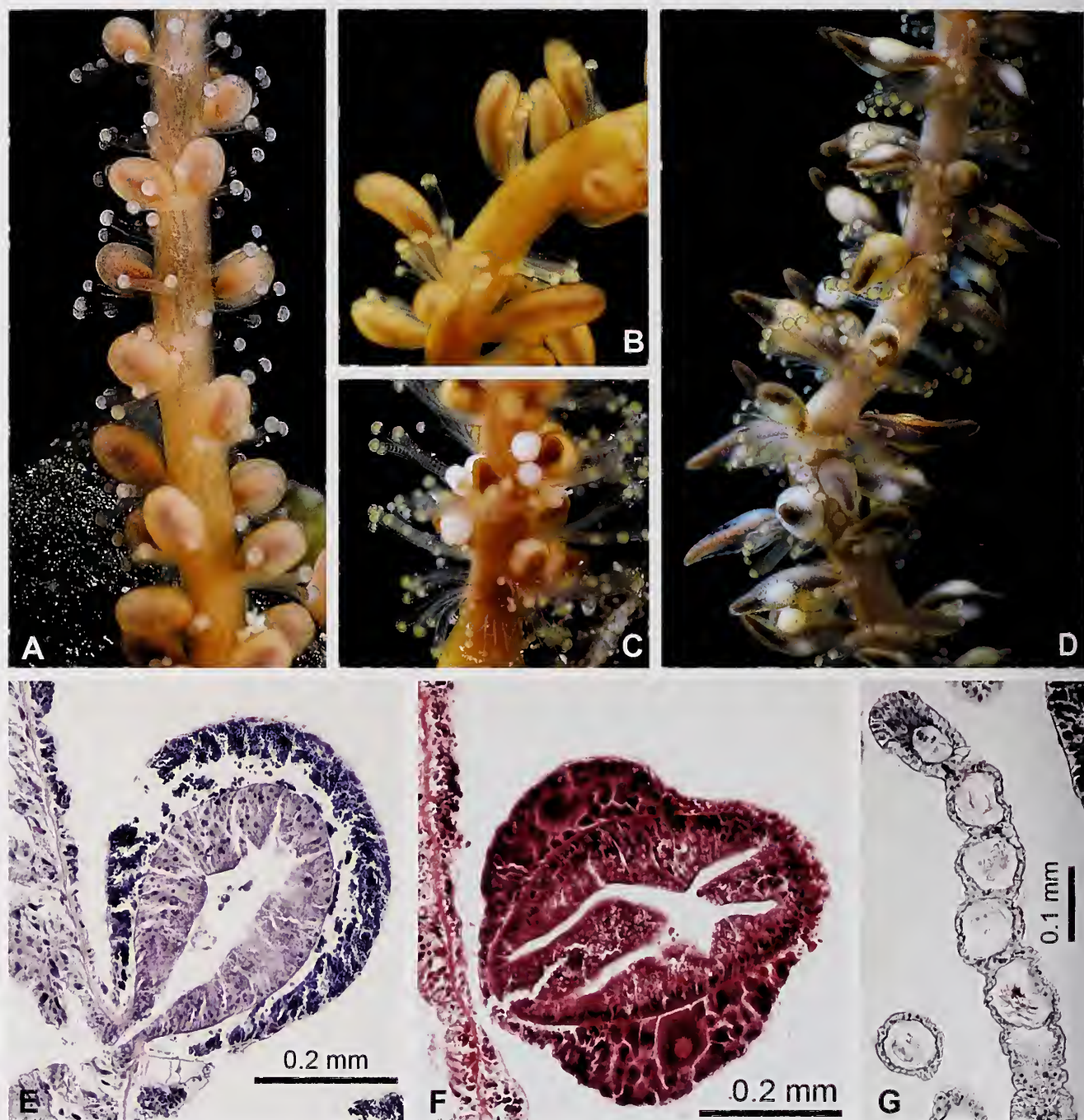


Fig. 2. *Monocoryne bracteata*, living animals, except E-G. (A) Young male sporosacs, Kam05. (B) Mature male sporosacs, Kam06. (C-D) Mature female sporosacs, likely after partial spawning, Kam06. (E) Longitudinal section through mature male sporosac, Kam05. (F) Longitudinal section through female sporosac with two growing oocytes surrounded by nourishing cells which will later fuse with the oocyte; Kam05. (G) Transverse section near the base of a tentacles group, note linear arrangement and shared epidermal layer.

Nematocysts (preserved tissue): Larger stenoteles (10.5-13)x(14-15) μ m; smaller stenoteles (8-9)x(11.5-13) μ m; desmonemes (5-6.5)x(7-9) μ m; microbasic heteronemes (5-6.5)x(13.5-18) μ m (Fig. 3A-D).

Dimensions: Fully grown expanded polyp 40 mm and more, diameter ca. 0.8 mm; preserved specimens about 10-15 mm. Expanded tentacles up to 1.5 mm long.

Sporosacs 0.8-2.1 mm long. Eggs maximally 0.35-0.5 mm in size.

Colours: Variable, yellowish-orange (Fig. 1A-B), pale-pink-orange, to orange-red. Surface of sporosac sometimes with rusty-red pigment clusters (Fig. 1B). Spadices of sporosacs when fully grown dark brown-red, eggs white when fully mature (Fig. 2C-D).



Fig. 3. *Monocoryne bracteata*, (A-D) Nematocysts of material preserved in 100% ethanol, Kam05, scale bar 10 µm valid for all images. (A) Stenoteles. (B) Desmonemes. (C) Microbasic heteronemes. (D) Shafts of discharged microbasic heteronemes. (E) Preserved specimens, all Kam05.

Other observation: One polyp with a bifid, Y-shaped body was found.

Biology: Found in depths of 7-16 m in gravel, attached to small stones, shell debris, or tubes of polychaetes.

Distribution: North Pacific; South-eastern Alaska (Fraser, 1943), Kamchatka Peninsula and Urup Island (this study), depth range 7-344 m.

Remarks: Hydroids of *Monocoryne* Broch, 1910, rare and seldom observed, are rather distinctive in having a large, worm-like body with numerous tentacles that are usually clustered in linear groups (Fig. 1A). Currently comprising four species (Schuchert, 2015), the genus has recently been reviewed by Stepanjants *et al.* (2003). Since that review, a new species (*Monocoryne colonialis*) has been described by Brinckmann-Voss & Lindner (2008) that had previously been mistaken by Stepanjants *et al.* for *M. bracteata*. One species of the genus, *M. minor* Millard, 1966, is restricted to South Africa. Meanwhile, *M. colonialis* is unusual in forming small colonies and in having tentacles that are

not in groups. These two species can be excluded from consideration in identification of the present material. The two remaining species, the Atlantic *M. gigantea* (Bonnevie, 1899) and the Pacific *M. bracteata* (Fraser, 1943) appear to be very similar morphologically. After examining type material of both species, Rees (1958) concluded that they could be conspecific. He kept them apart only because the type material of *M. bracteata* was in such a poor condition that it precluded any appropriate comparison. Both species are rare, *M. bracteata* was so far only known from type material consisting of two fragmented polyps. Apart from their geographic origin (Atlantic- versus Pacific Ocean), the two are currently only distinguished based on the maximal number of tentacles per cluster ("bract-like" clusters of Fraser, 1943), with 3-4 in *M. gigantea* and 4-7 in *M. bracteata* (Rees, 1956, 1958; Brinckmann-Voss & Lindner, 2008).

Rees (1958) claimed that *M. bracteata* might have hermaphroditic sporosacs as in *M. gigantea* (see Johannesen, 1924). However, he did not make histological

sections and without them, sex determination in preserved hydroids is difficult. Preserved Kamchatka samples were impossible to sex unambiguously without histological sections. Photos of the type specimen of *M. bracteata* show sporosacs with a few (4-5) egg-like bodies only, although Brinckmann-Voss & Lindner (2008) depict 7 in their drawing. Fraser (1943) shows many more, but his drawings tend to be somewhat inaccurate and his text states that they are "not numerous". The sample from Urup Island likewise had sporosacs with spindle-shaped spadices surrounded by 8-20 egg-like bodies (max. size 0.3 mm). However, a few sporosacs had no eggs at all and had presumably spawned already. It is therefore assumed that the low egg numbers per sporosac observed in the Kamtchaka material (Fig. 2C-D) is due to older sporosacs that had already liberated eggs. What appears as eggs in female sporosacs are often only clusters of nourishing cells surrounding a developing oocyte (Fig. 2F). Egg numbers per sporosac in *M. gigantea* are not known, but illustrations in Johannesen (1924) suggest low numbers as in *M. bracteata*.

The histological examinations (Fig. 2E-F) showed that the Kamchatka animals are clearly dioecious, in contradistinction to *M. gigantea* which is hermaphroditic (see Johannesen, 1924). This should be taken as a species specific difference.

As for the cnidome, the heteronemes (Fig. 3D) might be interpreted as microbasic euryteles with a faint swelling, but as is often the case in studies of preserved material they could be mastigophores instead.

The four 16S sequences obtained from *M. bracteata* were all either very similar or identical, adding further evidence that all the samples belong to the same species. The sequences are rather distant to all other Hydrozoa 16S sequences, but similar to an unpublished 16S sequence of *Monocoryne colonialis* (results not shown). To conclude, the numerous polyps from the Kamchatka Peninsula examined here most likely belong to *M. bracteata*, despite the following differences from the type specimens:

- shallow water (7-16 m) versus deep-water (>240 m)
- no attachment filaments; shorter foot region (2/3 of total height in type)
- fewer eggs per sporosac
- shape of fully grown sporosac more elongated.

The deep water specimen from Urup Island more closely resembles the type material of *M. bracteata*. All these differences were interpreted here as a combination of

intraspecific, environmentally induced, and age-related variations.

Candelabrum phrygium (Fabricius, 1780)

Figs 4-6, 7E-F

Lucernaria phrygia Fabricius, 1780: 343.

Myriothela arctica M. Sars, 1850: 134.

Myriothela phrygia. – M. Sars, 1877: 23, pl. 2 figs 29-36. – Bonnevie, 1899: 35, pl. 4 figs 5-6. – Jäderholm, 1908: 9, pl. 1 fig. 7. – Broch, 1916: 19, fig. C, pl. 1 figs 3 & 8. – Rees, 1957: 486, fig. 36. – in part Naumov, 1969: 261, not figures [= *C. cocksii*]. – Calder, 1972: 222, pl. 1 fig. 5.

? *Myriothela gigantea* Bonnevie, 1898: 490, pl. 27 figs 46-47. – Bonnevie, 1899: 38, pl. 4 fig. 1. – Rees, 1956: 115, synonym.

? *Myriothela minuta* Bonnevie, 1898: 489, pl. 27 fig. 44. – Bonnevie, 1899: 37, pl. 3 fig. 6a-b, pl. 4 fig. 4. – Rees, 1956: 115, synonym.

? *Myriothela mitra* Bonnevie, 1898: 489, pl. 27 fig. 43. – Bonnevie, 1899: 38, pl. 3 fig. 6c-e, pl. 4 fig. 3. – Rees, 1956: 115, synonym.

Myriothela verrucosa Bonnevie, 1898: 468, pl. 27 fig. 45. – Bonnevie, 1899: 37, pl. 4, fig. 2 & 2a. – Rees, 1956: 115, synonym.

Candelabrum phrygium – in part Cornelius, 1977: 521 [excl. synonymy]. – Segonzac & Vervoort, 1995: 45, figs 2e-f, 3E-F, table 1 [some references do not refer to this species]. – Schuchert, 2001: 37, fig. 24. – Schuchert, 2006: 346, fig. 8. – Antsulevich, 2015: 176, fig. 78A-B. not *Myriothela phrygia*. – Hincks, 1868: 77. – Allman, 1874: 317. – Allman, 1875a: 135. – Allman, 1875b: 250. – Allman, 1875b: 317. – Allman, 1876: 549, pls 55-58. – Hardy, 1891: 505, pls 36-37. – Blackburn, 1899: 58, pl. 8. – Hartlaub, 1916: 110, figs 38-39. [all = *C. cocksii*].

? not *Candelabrum verrucosum*. – Schuchert, 2006: 349, fig. 9.

Material examined

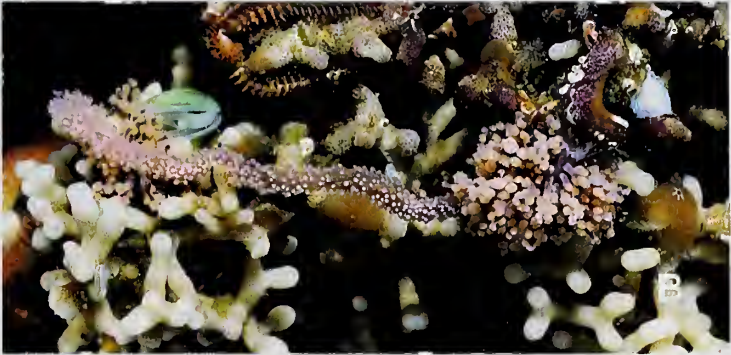
Type material:

Candelabrum verrucosum, UZMO B1376a through B1376g; 7 slides with serial histological sections, labelled "*Myriothela verrucosa*", from the Norwegian North-Atlantic Expedition. No locality data given. Bonnevie (1899) gives Hammerfest as origin, depth unknown.

Kamchatka material:

MHNG-INVE-92005, field number Kam01; 4 specimens in ethanol, male and female individuals; Russia, Kamchatka Peninsula, Avacha Bay, Starichkov

Fig. 4. *Candelabrum phrygium*, living animals. (A) Whole, semi-expanded polyp, male, size about 3-4 cm. Inset in upper corner: zoom on blastostyles with terminal nematocyst buttons and more proximal sporosacs (Kam08). (B) Semi-expanded polyp in its environment, size 2-3 cm. (C) Basal part of polyp (Kam03) showing attachment-tentacles with sucker-discs and blastostyles with female sporosacs. Inset in lower left: higher magnification of female sporosacs; note the numerous nematocyst buttons on their surface, this specimen has a particularly high number of them, others have fewer. Abbreviations: *sp* = sporosac, *bs* = blastostyle. (D) Basal part of a young polyp (Kam11) with sausage-shaped blastostyles bearing no sporosacs yet and also very few nematocyst buttons only. The blastostyles can easily be mistaken for sporosacs. ►



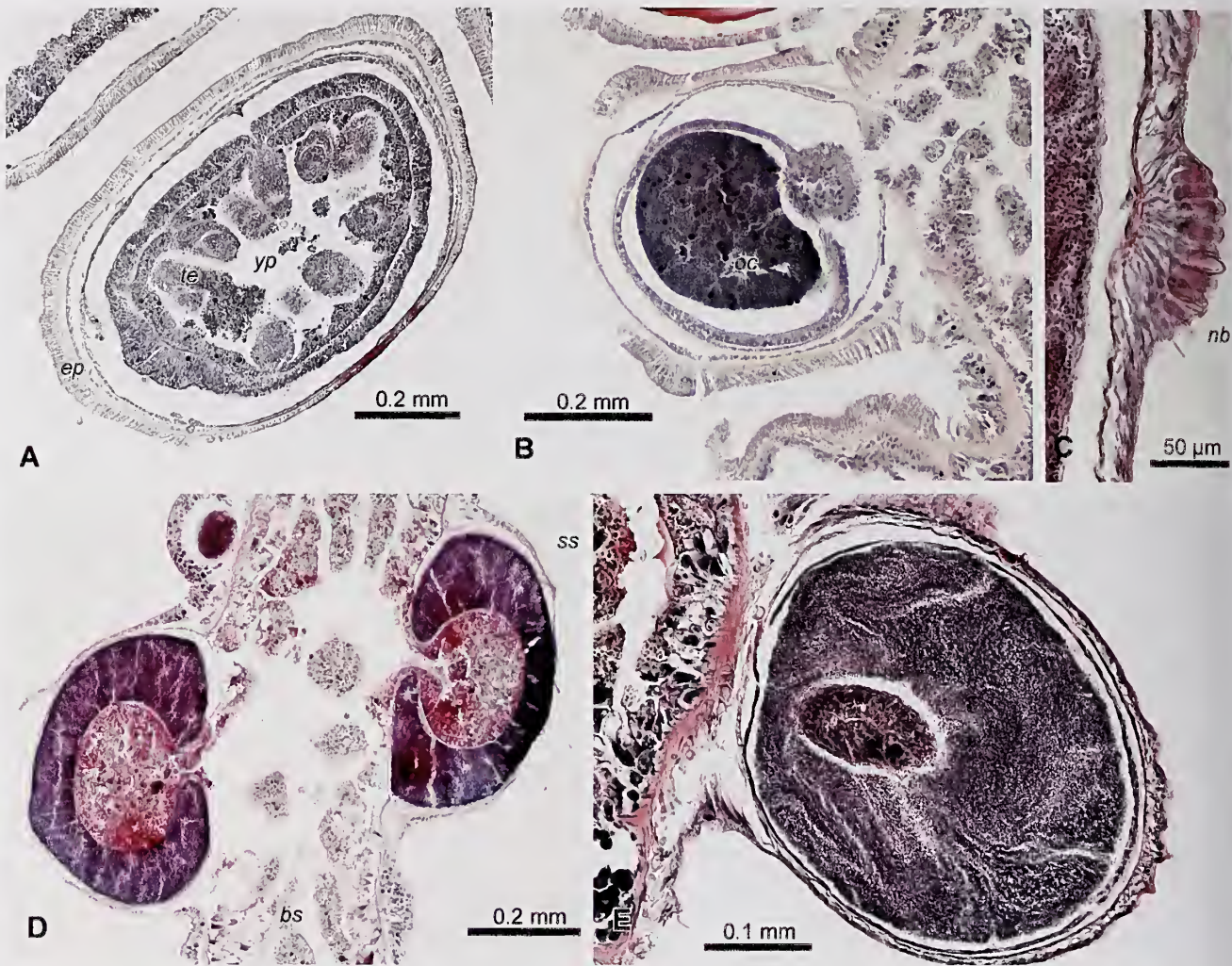


Fig. 5. *Candelabrum phrygium*, histological sections of blastostyles, oriented vertically, males and females originate from different, unisexual individuals, all Kam09. (A) Mature female sporosac with a young polyp (yp); ep = epidermis of sporosac. Note, the layers of the juvenile are inverted, the tentacles (te) directed towards the inside. This inversion is also known to take place in other *Candelabrum* species. (B) Youngest female sporosac observed, oc = oocyte. A part of the distal epidermis is lost. (C) Epidermis of a male sporosac with a nematocyst button (nb). (D) Two advanced male sporosacs, note the absence of a pedicel or stalk, the sporosacs arise within the epidermal layer, bs = blastostyle. (E) Mature male sporosac.

Island, 52.77457°N 158.611517°E, 23 m depth, temperature 0°C; collection date 13.09.2010.

MHNG-INVE-92006, field number Kam02, 3 female specimens in ethanol; Russia, Kamchatka Peninsula, Avacha Bay, Starichkov Island, 52.77457°N 158.611517°E, 23 m depth, temperature 0°C; collection date 13.09.2010.

MHNG-INVE-92007, field number Kam03, 8 specimens, male and female individuals in ethanol and serial histological sections of blastostyles of a male and a female individual; Russia, Kamchatka Peninsula, Avacha Bay, Starichkov Island, 52.77457°N 158.611517°E, 22 m depth, temperature 5°C; collection date 27.07.2010; DNA isolate 1120; 16S sequence LN898139.

MHNG-INVE-92008, field number Kam04, 1 male

specimen in ethanol; Russia, Kamchatka Peninsula, Avacha Bay, Starichkov Island, 52.774783°N 158.61048°E, 23 m depth, temperature 4°C; collection date 27.07.2010.

MHNG-INVE-92009, field number Kam08, 1 male and 1 female individual in ethanol; Russia, Kamchatka Peninsula, Avacha Bay, Bezimenniy Point, 52.84746°N 158.64323°E, 10 m depth, temperature 5°C; collection date 22.07.2009.

MHNG-INVE-92010, field number Kam09, 1 male specimen in ethanol and serial histological sections of 2 blastostyles; Russia, Kamchatka Peninsula, Avacha Bay, Starichkov Island, 52.77457°N 158.611567°E, 20 m depth, temperature 1°C; collection date 13.09.2010.

MHNG-INVE-92011, field number Kam10, 1 male

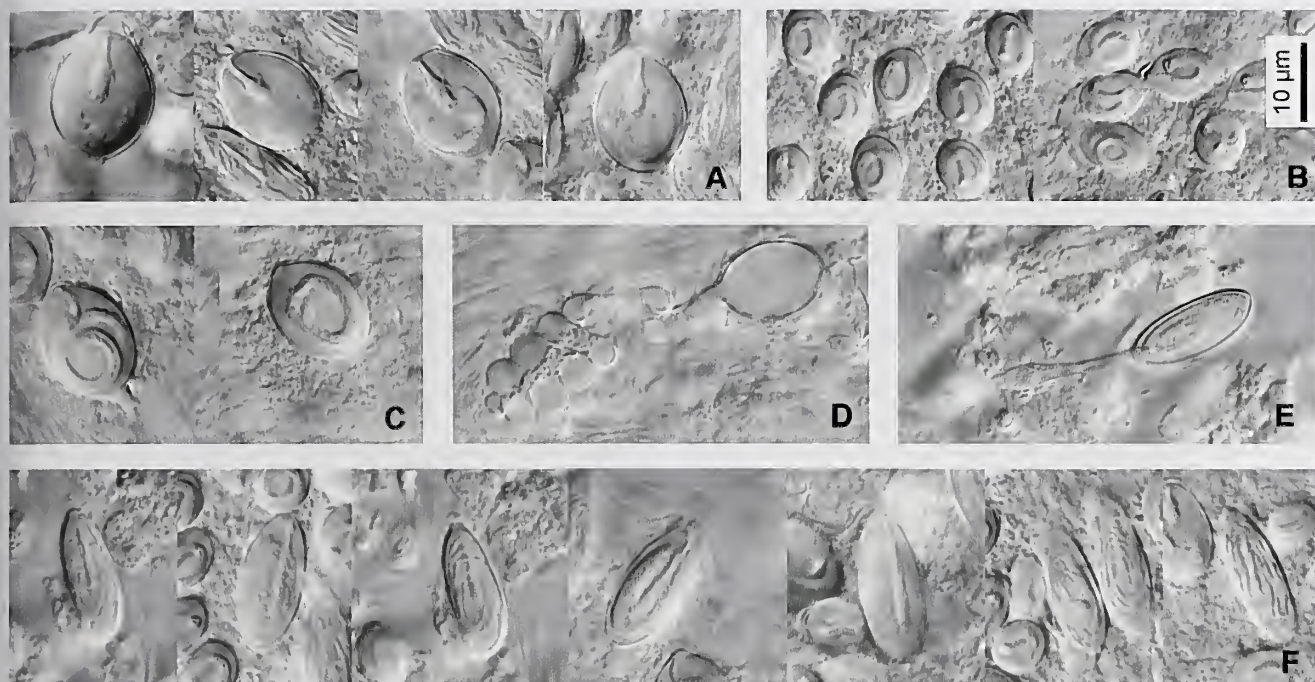


Fig. 6. *Candelabrum phrygium*, nematocysts of preserved animal (Kam12), scale bar valid for all images. (A) Stenoteles. (B) Small desmoneme. (C) Large desmonemes. (D) Discharged large desmoneme. (E) Discharged microbasic eurytele. (F) Microbasic euryteles.

in ethanol and serial histological sections of blastostyle; Russia, Kamchatka Peninsula, Avacha Bay, Starichkov Island, southern side, 52.77367°N 158.61983°E, 24 m depth, temperature 8°C; collection date 26.09.2010.

MHNG-INVE-92013, field number Kam11, 3-4 immature specimens in ethanol; Russia, Kamchatka Peninsula, Avacha Bay, Starichkov Island, behind Karaulny Kekkur, 52.77925°N 158.62348°E, 14 m depth, temperature 12°C, on the shell of a living gastropod *Fusitriton oregonensis*; collection date 27.08.2010; DNA isolate 1122; 16S sequence LN898141.

MHNG-INVE-92012, field number Kam12, 1 male specimen in ethanol; Russia, Kamchatka Peninsula, Avacha Bay, Mayachy Point, rock with sand, 52.88687°N 158.69633°E, 8 m depth, collection date 05.06.2014; DNA isolate 1121; 16S sequence LN898140.

Other Candelabrum phrygium material:

ZMUC-HYD-294; between Iceland and Jan Mayen Island, Ingolf station 117, 69.22°N 08.22°W, 1890 m; collection date 14.07.1896; identification P. Kramp; fragments of very large specimens in ethanol, blastostyles with relatively long tentacles, female sporosacs seen, sessile, without nematocyst buttons.

ZMUC-HYD-295; Greenland; identified by Lütken, collection date unknown; samples mentioned in

Schuchert (2006); 2 female specimens in ethanol and serial histological sections of blastostyles; body size 1-2 cm, rarely nematocyst buttons seen on some sporosacs.

ZMUC-HYD-296; Greenland; much fragmented and not well preserved specimen in ethanol, presumably male, some sporosacs with nematocyst buttons perhaps present.

ZMUC-HYD-297; north of Iceland, Ingolf Station 125, 68.13°N 16.03°W, 1373 m; collection date 29.07.1896; identified by H. Broch; 2 cm specimen in ethanol, blastostyles with tentacles but no sporosacs.

ZMUC-HYD-298; Greenland, Skovfjord, 10-35 m depth; collection date 05.09.1912; identified by P. Kramp; 1 nice specimen on red algae in ethanol, presumably male, some sporosacs with few nematocyst buttons.

ZMUC-HYD-299; between Iceland and Jan Mayen Island; Ingolf station 117, 69.22°N 08.22°W, depth 1890 m; collection date 14.07.1896; identification H. Broch; several black fragments in ethanol, female sporosac seen, no nematocyst buttons.

ZMUC-HYD-300; Greenland, Kap Farvel station 145, 60.07°N 43.20°W, depth 100 m; collection date 27.8.1970; 5 mm specimen in ethanol, juvenile, young sporosacs with or without nematocyst buttons, identity unclear.

Material of previously identified as Candelabrum verrucosum:

ZMUC-HYD-301; southernmost region of Greenland, Kap Farvel Expedition station 148, 60.07°N 43.20°W, 50 m depth; collection date 28.08.1970; 1 cm specimen in ethanol and serial histological sections of blastostyle (Fig. 7C-D), hermaphrodite; sporosacs with up to 10 nematocyst buttons [material mentioned in Schuchert (2006) as *Candelabrum verrucosum*].

Comparison material of Candelabrum cocksii:

MHNG-INVE-36299, 1 specimen in ethanol and histological sections of blastostyles. (see Schuchert, 2006: 341); France, Brittany, Roscoff, 48.73°N 4.00°W, 0 m depth; collection date 17.09.2004.

Type locality: Greenland (Fabricius, 1780).

Diagnosis: Solitary species of *Candelabrum* with polyps 1-10 cm or more in height when reproductive. Basal foot zone relatively short or absent, straight, not sheathed in envelope of perisarc, attached to substratum by tentacle-like filaments, filaments with or without terminal perisarc discs. Numerous blastostyles in part above foot and under tentacle zone, relatively long, 5 mm or more, straight, not branched, with very short capitate tentacles in distal third, often reduced to mere nematocyst buttons; clasper tentacles absent; sporosacs developing in epidermis, without peduncle and thus sessile. Individuals gonochoristic, females viviparous. Distal tentacle zone long and very extensible, with hundreds of short capitate tentacles.

Description of Kamchatka material

Morphology: Polyps solitary, vermiform, size highly variable in being able to expand and contract enormously. Hydranth shape also variable, usually cylindrical to conical, subdivided into distal tentaculate region (trunk), followed by blastostyle region and sometimes also a short foot zone. Foot zone either very short in relation to other parts or absent, not curved, adhering to substratum by several tentacle-like attachment filaments, each with terminal sucker-like ending, the latter sometimes with a disc of perisarc that adheres to substratum, but perisarc discs often absent.

Blastostyle region about 1/4 to 1/3 length of polyp (Fig. 4A), beset by many (>20) simple club-shaped, unbranched blastostyles. Distal end of blastostyles with four to six nematocyst clusters in wart-like

tubercles, number and distribution very variable. Mature blastostyles bearing spherical to hemispherical sporosacs lacking a pedicel, hence sessile (Fig. 5D). Male sporosacs without radial canals, up to 25 per blastostyle at different developmental stages. Female polyps with up to 12 sporosacs per blastostyle, sporosacs without radial canals, eggs fertilized in situ and developing into young polyps, hence viviparous (Fig. 5A, 7C). On surface of sporosacs 1-20 nematocyst buttons, some sporosacs without buttons. All examined polyps unisexual.

Trunk region comprising majority of hydranth length, with numerous (>200) capitate tentacles, these hollow, extensible, capitula oblong.

Dimensions: 1-20 cm in height (maximal size only in situ and when fully expanded), preserved material difficult to assess due to strong contractibility. Blastostyles 5 mm long. Male sporosacs about 0.4-0.5 mm, female sporosacs up to 0.9 mm,

Colours: cream-white, pinkish or orange-yellow.

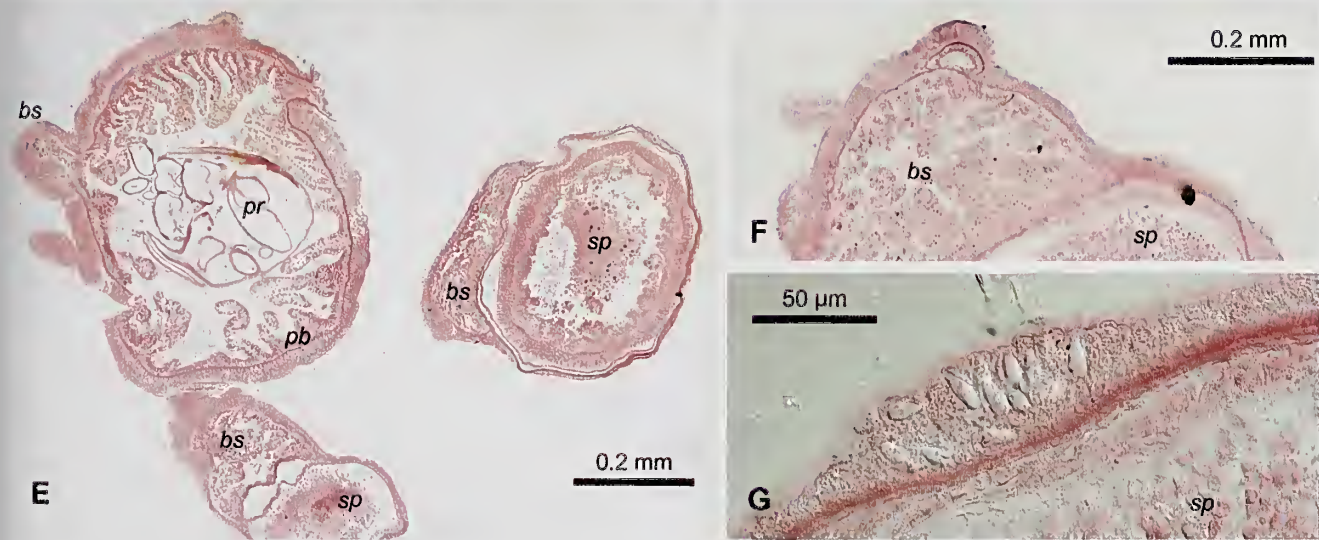
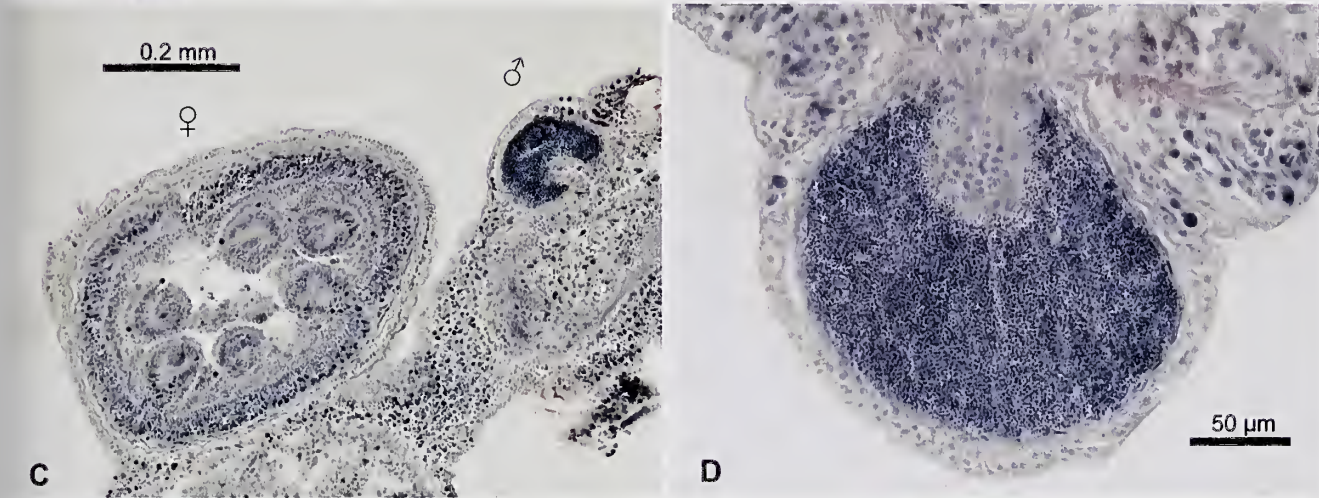
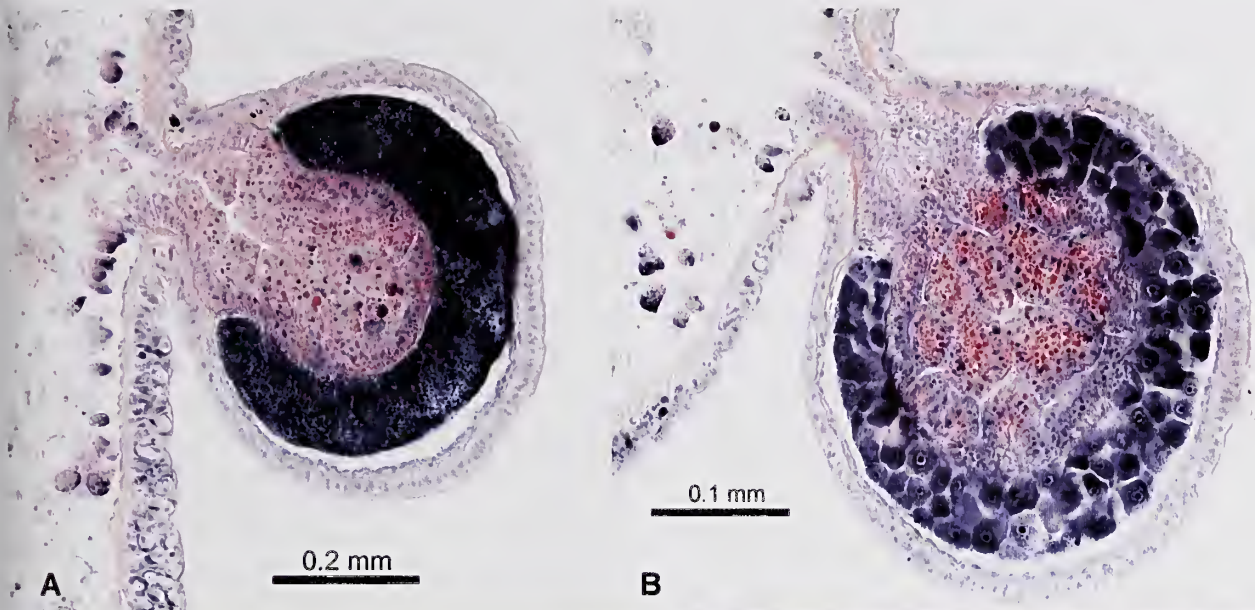
Nematocysts of preserved animals: stenoteles (Fig. 6A), of two size classes, (12.5-16) × (8.5-13.5) μm; small desmonemes (Fig. 6B), (8-9.5) × (5.5-6) μm; large desmonemes (Fig. 6C-D), (14.5-16) × (9-12.5) μm, discharged filament with 5-6 coils; microbasic euryteles with distinctly swollen shaft, shaft somewhat longer than capsule when discharged (Fig. 6E-F), (15-22) × (5.5-8) μm.

Distribution: An Arctic species penetrating into Boreal regions, in the Atlantic waters reaching as far south as the Trondheimfjord (shallow waters) and in deep waters south-west of the Azores (Schuchert, 2006). It has also been recorded in the Russian Arctic seas and the northern Pacific (Paramushir Island, south of Kamchatka Peninsula; Naumov, 1969). (Note that numerous other records under this name from coastal regions of the NE Atlantic refer actually to *Candelabrum cocksii*; see Schuchert, 2006.)

Biology: Occurs usually at considerable depths of several hundreds of meters down to 2195 m (Bonnievie, 1899), but in the high Arctic it has been found as shallow as 13 m (Jäderholm, 1908). The current findings from Kamchatka confirm that it also occurs in shallow (8-23 m) depths.

The polyps live permanently attached to solid substrata like rock, bivalves, hydroids, bryozoans, and algae. The present material was found on stones and frequently

Fig. 7. (A-B) *Candelabrum cocksii*, longitudinal sections of sporosacs of the same blastostyle, MHNG-INVE-36299. (A) Mature male sporosac. (B) Young female sporosac with many differentiating oocytes. (C-D) *Candelabrum* spec. from Greenland, ZMUC-HYD-300, hermaphrodite, longitudinal section of a single blastostyle and its sporosacs. (C) Left a female sporosac with young polyp (tentacles inverted), adjacent a small, developing male sporosac with maturing spermatozooids. (D) Small male sporosac with spermatozooids of an advanced stage. (E-F) *Candelabrum verrucosum*, holotype. (E) Horizontal section in region of blastostyles. (F) Blastostyle with developing tentacle (top). (G) Nematocyst button on sporosac. Abbreviations: *bs* = blastostyle, *pb* = polyp body, *pr* = prey item, *sp* = sporosac.



on the bryozoan *Myriopora orientalis* (Fig. 4B). Two young specimens (Kam11) were found on the shell of a living gastropod *Fusitriton oregonensis* (Redfield).

Like other *Candelabrum* species, *C. phrygium* is viviparous and lacks a planula phase (Sars, 1877; Schuchert, 2006). The newly released polyp is spherical and has 20-30 capitate tentacles. The tentacles formed while the embryos are still in the sporosac develop inverted into the gastric lumen (Fig. 5A), but they revert to the outside before hatching (comp. Allman, 1876; Schuchert, 2006).

Remarks: All *Candelabrum* species have been reviewed by Segonzac & Vervoort (1995), but many remain difficult to separate if no biogeographic information is considered. The Kamchatka material conforms well to existing descriptions of the Arctic *Candelabrum phrygium* (e. g. Segonzac & Vervoort, 1995; Schuchert, 2006), except for the presence of nematocyst buttons on the sporosacs (Figs 4C, 5B-C). These buttons occur in variable numbers from 1 to 20 per sporosac, and occasional sporosacs also lack them. The presence of such nematocyst buttons has been deemed diagnostic for the species *Candelabrum verrucosum* (Bonnevie, 1898) (Segonzac & Vervoort, 1995; Schuchert, 2006), but a re-evaluation is necessary. *Candelabrum verrucosum* is a very rare, poorly described species. After examining the type material, Rees (1956) considered it conspecific with *C. phrygium*. Segonzac & Vervoort (1995) kept it distinct, but had no new material. The only specimen-based record of *C. verrucosum* after the first description was that of Schuchert (2006). The identification of his Greenland specimen relied on the presence of nematocyst buttons, which were presumed to be diagnostic for the species. The simultaneous presence of both male and female sporosacs (Fig. 7C) distinguished the sample clearly from the *C. phrygium*, which is gonochoristic (Segonzac & Vervoort, 1995).

However, the identity of *C. verrucosum* warrants reappraisal. Bonnevie's (1898) description of the species was cursory, and suitable illustrations were not provided. Bonnevie mentioned the presence of flat radial canals in the gonophores, which would be quite unusual for the genus (comp. Briggs, 1928, 1929, 1931; Manton, 1940). Moreover, there was a small gastrodermal vesicle (depicted in Bonnevie, 1899: pl. 4 fig. 2a) under the nematocyst buttons of young sporosacs in Bonnevie's material, something never seen in the present material and also not observed in the material of Schuchert (2006; see Fig. 7C-D). Another error in the original description seems likely, as Bonnevie (1898) stated that the essential diagnostic trait of the species was the existence of nematocyst buttons on the blastostyle, while in the preceding paragraph she described them as being on the gonophores. In the following section she described more histological details, but referred to the blastostyle instead of a gonophore. In order to get a clearer picture,

it was thus necessary to re-examine the type material of *C. verrucosum*, obtained on loan from the Natural History Museum of Oslo University. The type material was not labelled as such, but there can be no doubt that this is what remains from the holotype of *C. verrucosum*. The material is apparently from the "N. Nordhavsekspedition" and is clearly labelled as *Myriothela verrucosa*; moreover, Bonnevie (1898) stated that she made histological sections. The material consists of seven microscope slides with stained, serial histological sections. The slides are marked with a letter ranging from a through g. The tissues are not well preserved, something already deplored by Bonnevie (1898: 487), and it takes some effort to identify what is present on the slides (Fig. 7E). The presence of the tentacle zone in the last slides and the presence of a prey item in the gastric system permit an identification and orientation of the sectioned parts. Slides a-f contain horizontal sections of the whole polyp ranging from the blastostyle region (Fig. 7E) to the beginning of the tentacle zone. Slide g, in contrast, contains serial longitudinal sections of a blastostyle with two sporosacs. The slides allow corrections and additions to be made to Bonnevie's account:

- there is no evidence of male sporosacs; all appear to be female, the most advanced containing a young polyp with inverted tentacles, so the animal is thus likely gonochoristic.
- there are only very few nematocyst buttons on the sporosacs (Fig. 7G) and there is no gastrodermal vesicle below it. The situation is identical to that seen in the new material (Fig. 5C).
- sporosacs have no radial canals or any vestiges of them.
- the nematocyst buttons and the underlying "small gastrodermal vesicles" depicted in Bonnevie (1899: pl. 4 fig. 2a; here 7F) most likely represent a small tentacle on the blastostyle (the "small gastrodermal vesicle" is in fact the lumen of the tentacle). The vesicles definitely do not occur on mature sporosacs (Fig. 7G).

From a re-examination of the type material of *C. verrucosum* and other historical material of *C. phrygium*, we conclude that there is no evidence to warrant separation of the two species. As already concluded by Rees (1957), *C. verrucosum* must be regarded as a synonym of *C. phrygium*.

Re-examination of material of *C. phrygium* from the ZUMC revealed that historical samples of the species (see material examined) may also have occasional nematocyst buttons on the sporosacs, but never as many as seen in some females of specimens from Kamchatka. The sole presence of these nematocyst buttons is thus not diagnostic for *C. verrucosum*. The possible developmental origin of nematocyst buttons in Kamchatka material is also important in this context. The gonophores develop from cell aggregations at the base of the epidermis as described for *C. penola* by Manton (1940: fig. 3). In

contrast to *C. cocksii* (Fig 7A-B), no stalk develops and the sporosacs remain sessile (Fig. 5B-D) while the original blastostyle epidermis stretches over them. The blastostyles may also bear at their end short capitate tentacles or mere nematocyst buttons (comp. Fig. 4A or Schuchert, 2006: fig. 8B). These tentacle rudiments may end up on the surface of a growing sporosac, possibly explaining their occasional presence. However, the large numbers seen here (e. g. Fig. 4C) are clearly an additional development. Although certainly not enough material has been examined for a well-founded conclusion, it is interesting to note that only colonies from shallow waters (7-50 m) had numerous buttons, while deep water specimens had none or only a few. This can of course also be used as an argument to separate the two groups into two distinct species, but we prefer to think that the number of nematocyst buttons is environmentally related, e. g. induced by unspecific predators/browsers like nudibranchs, which are presumably more abundant in shallow waters. We therefore consider the presence of nematocyst buttons alone as insufficient justification to regard *C. verrucosum* as distinct, and the Kamchatka material is assigned to *C. phrygium*. The high number of nematocyst buttons on female sporosacs is here considered to constitute intraspecific variation or to be environmentally induced. Moreover, *Candelabrum phrygium* has already been recorded from the region by Naumov (1969, Paramushir Island).

If presence of nematocyst buttons on the sporosacs is insufficient basis to distinguish *C. verrucosum* as a valid species, then the identification of Schuchert (2006) of a Greenland specimen as *C. verrucosum* has to be revised. This material is clearly hermaphroditic (Fig. 7C) and thus different from all known samples of *C. phrygium*. So far, only two hermaphroditic species of *Candelabrum* are known, namely *C. cocksii* and *C. serpentarii* Segonzac & Vervoort, 1995. *Candelabrum cocksii* is a distinct species, easily separable by its characteristic clasper tentacles which hold the encapsulated developing embryos (Schuchert, 2006). *Candelabrum serpentarii*, on the other hand, differs only from *C. phrygium* in being hermaphroditic (Segonzac & Vervoort, 1995). Note that size differences in *Candelabrum* are of minor importance as reproductive animals can vary in size by an order of magnitude (e. g. *C. penola*, Manton, 1940). Likewise, the nematocyst types are rather uniform and any observed differences are of little use for the few, allopatric specimens that are available. Photographs of the type specimen of *C. serpentarii*, kindly provided by Dr A. Andouche (Muséum National d'Histoire Naturelle, Paris), showed no evidence of nematocyst buttons. Some of the sporosacs contain young polyps, while others are smaller and opaque. Without histological sections it is impossible to determine their sex. Segonzac & Vervoort (1995) apparently did not make histological sections, and their interpretation that the animal is hermaphroditic needs reconfirmation. Nevertheless, it could be that also hermaphroditism is part of the intraspecific variability of

C. phrygium (perhaps it is a sequential hermaphrodite) and this has not been seen due to the small number of specimens examined histologically.

To clarify species limits within the genus *Candelabrum*, and to settle the identity of specimens examined here, more samples of these rare species are needed and additional molecular genetic analyses must be undertaken. The three 16S sequences of the Kamchatka material obtained here are minimally different, and BLAST searches in GenBank (results not shown) gave as the closest match *Candelabrum austrogeorgiae* (accession number FN424120). Unfortunately, insufficient data are currently available from other species for a more detailed taxonomic assessment.

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Special thanks are also due to Janik Pralong (MHNG) for the histological preparations she made for us.

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Revision of *Cebrenninus* Simon, 1887 with description of one new genus and six new species (Araneae: Thomisidae)

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Abstract: The crab spider genus *Cebrenninus* Simon, 1887 is redefined based on morphology of adult males and females. *Cebrenninus* now is constituted of 10 nominal species. The following new species are described: *Cebrenninus banten* sp. nov., *C. berau* sp. nov., *C. magnus* sp. nov., *C. phaedrae* sp. nov., *C. schawalleri* sp. nov., and *C. tangi* sp. nov. Three new synonyms are proposed: *Libania scabricula* Thorell, 1890 syn. nov., *Libania scabricula sulcata* Thorell, 1890 syn. nov., and *Libania annulata* Thorell, 1890 syn. nov. = *Cebrenninus rugosus* Simon, 1887. *Cupa kalawitana* Barrion & Litsinger, 1995 is removed from the synonymy of *C. rugosus* and placed as a distinct species in *Cebrenninus*, i.e. *C. kalawitana* (Barrion & Litsinger, 1995) comb. nov. Morphological comparison of *Cebrenninus* and *Ascurisoma* Strand, 1929 shows that the latter should be considered a junior synonym of the former. Thus, *Ascurisoma striatipes* (Simon, 1897) is transferred to *Cebrenninus*, *C. striatipes* (Simon, 1897) comb. nov. *Crockeria kinabalu* gen. et sp. nov. from Mt Kinabalu National Park, Sabah, is described on the basis of its exceptional palp which has a median apophysis in addition to conductor and embolus. *Libania laevis* Thorell, 1890 syn. nov. is transferred to this new genus, now being called *Crockeria laevis* (Thorell, 1890) comb. nov.

Keywords: Stephanopinae - systematics - taxonomy - biodiversity - relict - Southeast Asia - China - Sri Lanka.

INTRODUCTION

The current biodiversity crisis has led to rush large scale collecting and to studies of many tropical faunas; crab spiders are no exception (Barrion & Litsinger, 1995; Tang & Li, 2009, 2010a, b; Tikader, 1980). However, many recent taxonomic treatments of crab spiders of tropical Asia have failed to examine name bearing type specimens of described species, resulting in the creation of superfluous names and misidentified species (Benjamin, 2011, 2013). Undeniably, although crab spiders are rather common worldwide, many genera have never been adequately characterized, rendering identification of newly collected material difficult. This paper is the third of a series presenting results of collections made by Christa Deeelman-Reinhold and coworkers of spiders living in the forest canopy, as well as collections made by Peter Schwendinger of spiders living in leaf litter. It deals with representatives of the genus *Cebrenninus* (Benjamin, 2013, 2014). These are cryptic, dark brownish spiders that live in dead, dry plant material such as bark and leaf litter. They are distributed throughout tropical Asia.

Spiders of the monotypic genus *Ascurisoma* Strand, 1929 (a replacement name) have never been collected or studied since its description by Simon (1897). Here I redescribe and diagnose *Ascurisoma striatipes* (Simon, 1897) on the basis of newly collected material and transfer it to *Cebrenninus*. This is the only known species of the genus found outside Southeast Asia and most probably it is an evolutionary relict.

MATERIAL AND METHODS

Types and other specimens were borrowed from the following institutions: CAS California Academy of Sciences, San Francisco; MCSN Museo Civico di Storia Naturale “Giacomo Doria”, Genova; MHNG Muséum d’histoire naturelle, Genève; MNHN Muséum National d’Histoire Naturelle, Paris; RMNH Rijksmuseum van Natuurlijke Historie, Leiden; SMF Research Institute Senckenberg, Frankfurt am Main. Methodology follows Benjamin (2011). Specimens used for habitus illustrations were placed in 70% ethanol and photographed using a dissecting microscope (Zeiss Discovery V20) with top

illumination and a magnification of up to 150x. Digital images were taken with a Zeiss AxioCam HRc camera. Images were edited using the Zeiss ZEN Pro software package.

An Amray 1810 housed at the Smithsonian Institution's National Museum of Natural History Scanning Electron Microscope (SEM) facility was used to study and photograph morphological features; relevant methodology is given in detail in Benjamin (2011). Structures of the left body side are depicted unless stated otherwise. Setae are usually not depicted in the final palp drawings. All measurements are given in millimeters. The leg formula is from the longest to the shortest leg. Abbreviations of morphological structures: ALE = anterior lateral eyes, AME = anterior median eyes, C = conductor, CD = copulatory duct, CO = copulatory opening, E = embolus, ETP = extra tegular process, MA = median apophysis, PLE = posterior lateral eyes, PME = posterior median eyes, RTA = retrolateral tibial apophysis, S = spermatheca, STD = sperm duct; connected to embolus.

TAXONOMIC PART

Thomisidae Sundevall, 1833

Cebrenninus Simon, 1887

Ascurisoma Strand, 1929. **Syn. nov.** Replacement name for *Ascuris* Simon, 1897.

Types species: *Cebrenninus rugosus* Simon, 1887.

Diagnosis: Distinguished from other thomisid genera by a combination of the following characters: Presence of a large stout RTA, presence of a free embolus that originates at the center of the bulb, presence of a filiform C, and presence of at least one SDT bend (inward turn). Males also possess a second tegular sclerite, the ETP. All males of the genus lack a MA. In some species males and females lack PME. In *C. rugosus* only females lack PME. Females can be distinguished from those of all other Thomisidae by the presence of large globular spermathecae and by the presence of a CD that is only slightly longer than the thickness of the wall of the S.

Species composition: *Cebrenninus banten* sp. nov., *C. berau* sp. nov., *C. kalawitana* (Barrion & Litsinger, 1995) comb. nov., *C. magnus* sp. nov., *C. phaedrae* sp. nov., *C. rugosus* Simon, 1887, *C. schawalleri* sp. nov., *C. srivijaya* Benjamin, 2011, *C. striatipes* (Simon, 1897) comb. nov. and *C. tangi* sp. nov.

Distribution: China, South-East Asia and Sri Lanka.

Remark on synonymy: The type species of *Ascurisoma*, *A. striatipes* (Simon, 1897), is here considered a typical member of *Cebrenninus* as it meets the criteria given in the diagnosis below.

Cebrenninus banten sp. nov.

Figs 1-3

Holotype: RMNH.ARA.15937; male; Indonesia, Banten Province, West Java, Ujung Kulon Reserve, 6°44'48"S 105°20'1"E, 11.-12.1986, leg. Suharto Djojosedharmo; left legs 1, 2 and 3 missing.

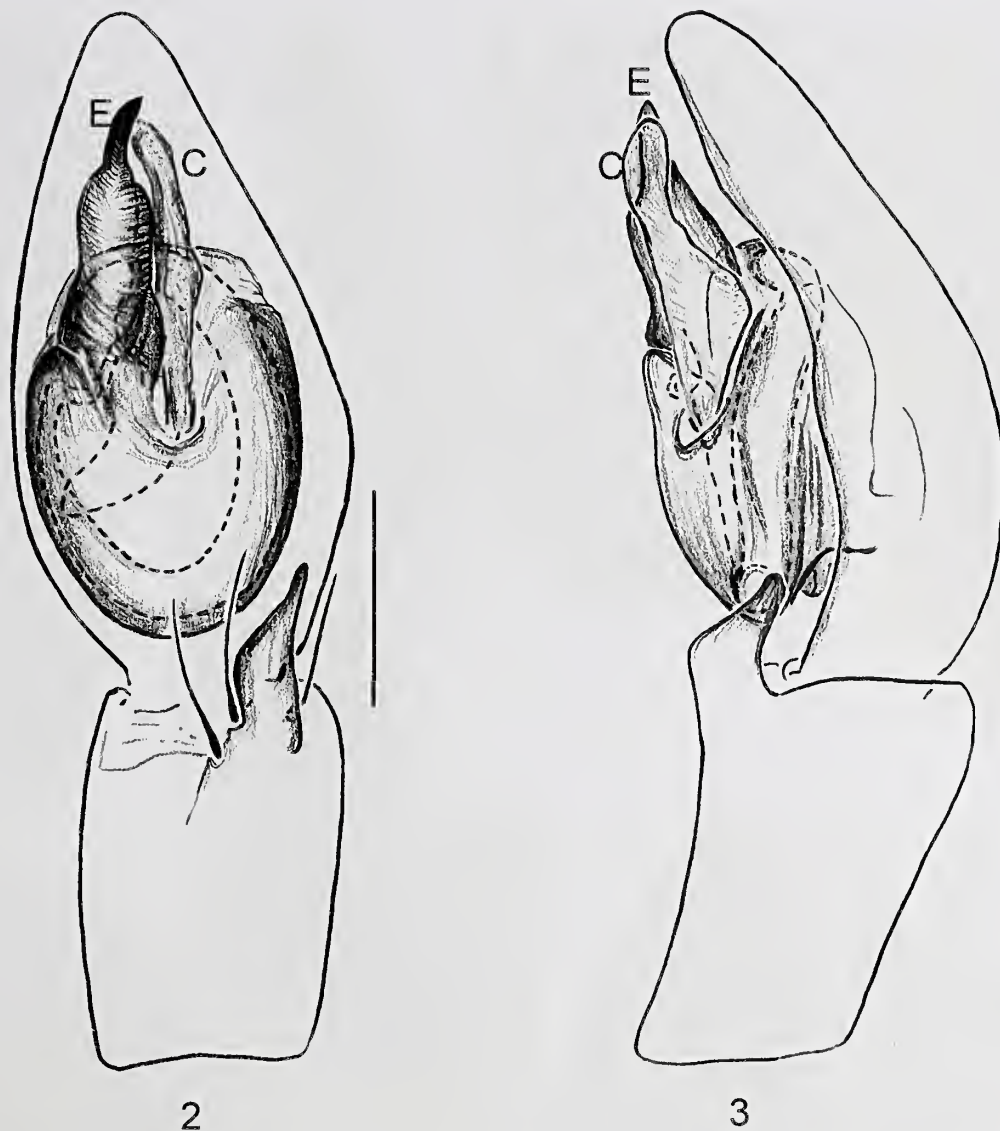
Diagnosis: Easily distinguishable from other known congeners by distinctive shape of E (fine tapered tip), C (weakly sclerotized, more or less the same width along its entire length, concave tip) and RTA (fine tapered tip; Figs 2-3).

Etymology: The species name is a noun in apposition derived from the name of the province in which the type locality lies.

Description: *Male:* Total length: 4.2; prosoma length: 2.0, width: 1.8. Leg I: femur 2.4, patella 0.8, tibia 2.5, metatarsus 2.3, tarsus 0.8. Prosoma red-brown, rounded, eight eyes, LE on light brown-colored mounds, mounds distinct but not touching (Fig. 1). ALE > PLE > PME > AME, AER and PER recurved. Opisthosoma dorsally with irregular black diffused spots, with brown circular spots towards the center and laterally with black spots connected to form bands. Legs uniformly yellow-brown. Leg formula 1243. Chelicera with three promarginal and three retromarginal teeth. Palps as in Figs 2-3.



Fig 1. *Cebrenninus banten* sp. nov., male holotype from Indonesia. (1) Prosoma, dorsal view. Scale line = 1.0 mm.



Figs 2-3. *Cebrenninus banten* sp. nov., male holotype from Indonesia. (2-3) Left male palp (2 ventral, 3 retrolateral view). Scale lines = 0.2 mm.

Cymbium of male palp lacking trichobothria, C with concave tip, E stout with a short filiform tip.

Female: Unknown.

Distribution: Known only from the type locality.

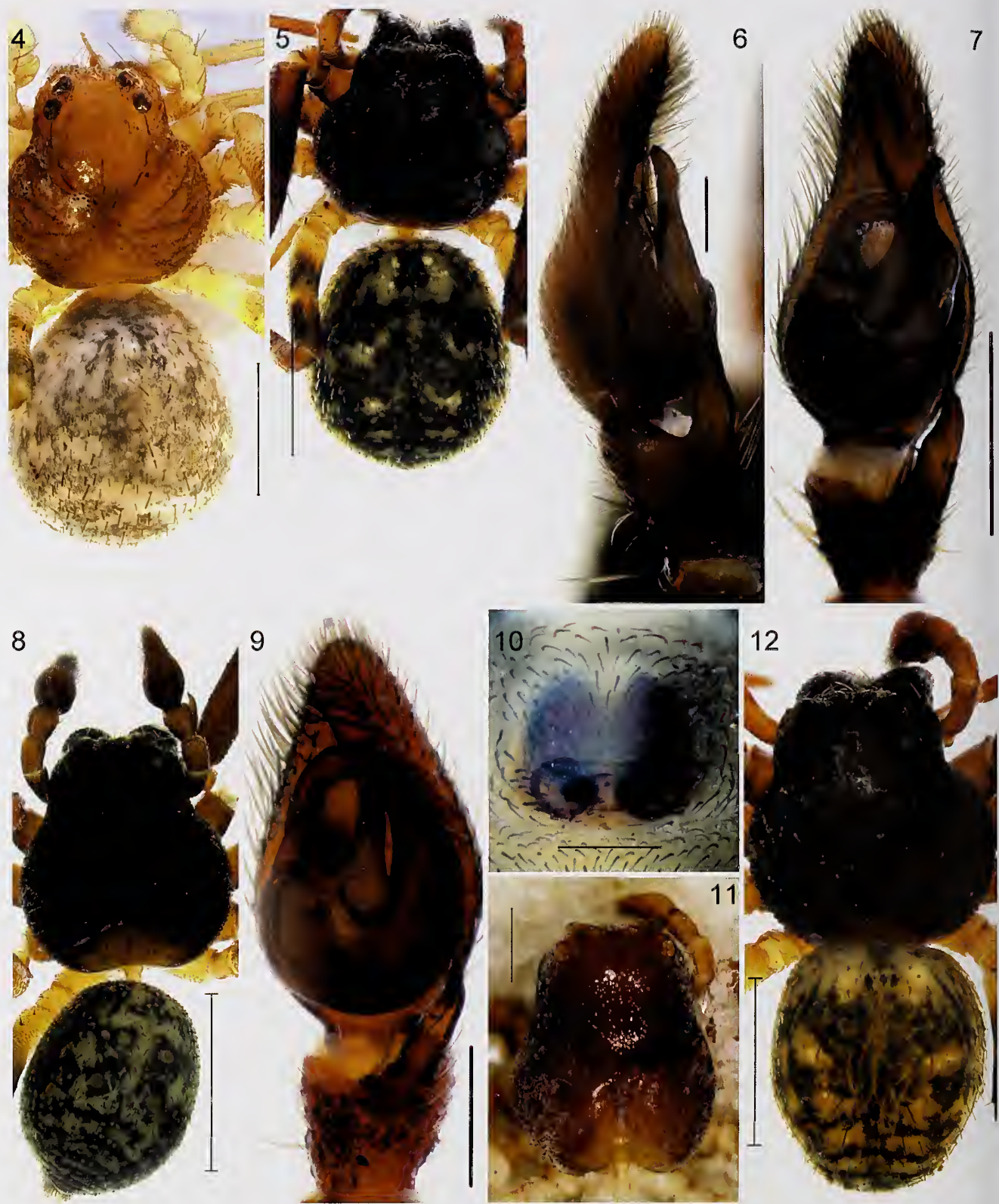
***Cebrenninus berau* sp. nov.**

Figs 4-5, 10, 13-16, 30-31, 33-34

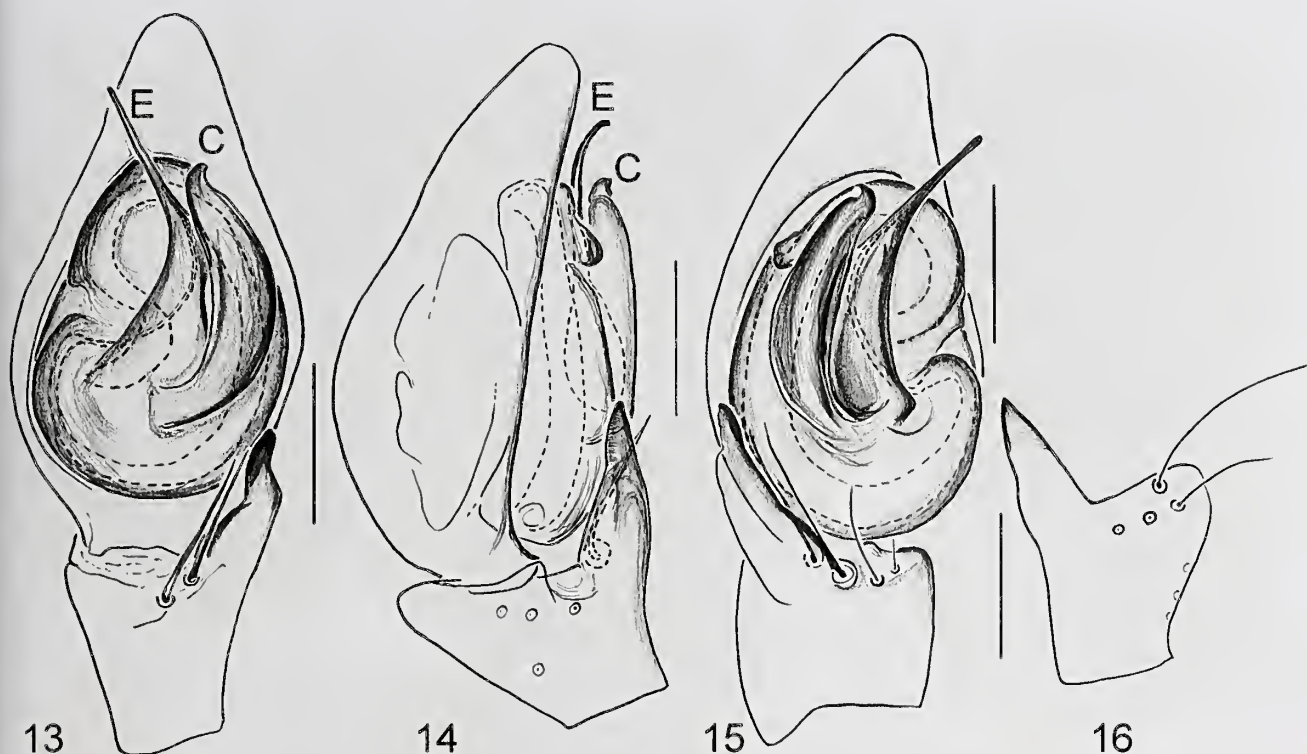
Cebrenninus rugosus.— Ramírez, 2014: 223, fig. 151d. Misidentification.

Holotype: MHNG; male; Indonesia, East Kalimantan Province, Berau District, 1 km off road Tanjungredeb to Tanjungseler, ca 45 km N of Tanjungredeb, 2°29'33"S, 117°28'46"E, 190 m, primary forest; 29.9.2008 to 3.10.2008; leg. P. Schwendinger (sample IND-08/07).

Other material examined: RMNH.ARA.17165; 1 male, 1 female, 6 juveniles; Indonesia, North Sumatra, Gunung Leuser, Bohorok, litter; 10.08.1982; leg. C.L. and P.R. Deeleman. — RMNH.ARA.17166; 6 males, 12 females; Indonesia, North Sumatra, Gunung Leuser, Ketambe; 2.-4.03.1986; leg. Suharto Djojosedharmo; second date given on label 3.-5.04.1986, trail 64; in addition to the above listed specimens, this sample contained several specimens of *C. phaedrae* sp. nov. — RMNH.ARA.17167; 8 males, 4 females; same locality and collector, lowland leaf litter; 01.05-09.08.1986; in addition to the above listed specimens, this sample contained several specimens of *C. phaedrae* sp. nov. — MHNG; 2 males, 11 females, 9 juveniles, collected with the holotype (sample IND-08/07). — RMNH.ARA.15944; 1 male (damaged, opisthosoma missing, left palp missing); East Malaysia, Borneo, E. Sabah,



Figs 4-12. (4-5, 10) *Cebrennimus berau* sp. nov. from Indonesia, Berau District. (6-8) *C. magnus* sp. nov., holotype. (9, 11-12) *C. rugosus* (9, 12 from Pagat, 11 male lectotype; MNHN 8652/1572). (4, 8, 12) Male, dorsal view. (5, 11) Female, dorsal view. (6-7, 9) Left male palp (6 retrolateral, 7, 9 ventral view). (10) Epigynum, ventral view. Scale lines = 0.2 mm (6, 9, 10), 0.5 mm (7, 11), 1.0 mm (4-5, 12), 2.0 mm (8).



Figs 13-16. (13-14) *Cebrenninus berau* sp. nov., male from Sabah, right palp (13 ventral, 14 retrolateral view). (15) *C. berau* sp. nov., holotype from Berau District, left palp, ventral view. (16) Same palp, RTA, retrolateral view. Scale lines = 0.2 mm.

Danum Valley Field Centre, primary forest, dung trap; 1991; leg. Andrew Davis.

Diagnosis: Similar to *C. phaedrae* sp. nov. and *C. kalawitana* comb. nov., distinguished from these and other known congeners by distinctive shape of E (broad base, slightly enlarged in the center, finely tapered towards tip, tip slightly enlarged; Figs 13, 15), C (curved margins, hooked tip; Figs 13, 30) and RTA (hooked tip; Figs 13-16, 31). Females can be distinguished by the oval spermathecae and by the short CD that seems to be a bit longer than the width of the wall of the S (Figs 33-34). Moreover, both sexes of this species are larger and darker in color than *C. phaedrae* sp. nov.

Etymology: The species name is a noun in apposition taken from the name of the district in which the type locality lies.

Description: *Male:* Total length: 3.1; prosoma length: 1.5, width: 1.4. Leg I: femur 1.8, patella 0.6, tibia 1.7, metatarsus 1.2, tarsus 0.8. Prosoma red-brown, rounded, six eyes, PME absent, LE on light brown-colored mounds, mounds distinct but not touching (Fig. 4). Opisthosoma dorsally with irregular black diffused spots, two pairs of brown circular spots towards the center, laterally black spots connect to form bands (Fig. 4). Legs uniformly yellow-brown. Leg formula

1243, ALE > PLE > AME, AER and PER recurved. Palps as in Figs 13-16, 30-31. Cymbium of the male palp lack trichobothria.

Female: Total length: 3.3-4.0; prosoma length: 1.5-1.7, width: 1.3-1.5. Leg I: femur 1.8, patella 0.5, tibia 1.5, metatarsus 1.0, tarsus 0.7. In general similar to male. Epigynum and vulva as in Figs 33-34. Spermathecae oval, CD short.

Distribution: Known from localities in northern Sumatra and eastern Borneo.

***Cebrenninus kalawitana* (Barrion & Litsinger, 1995)
comb. nov.**

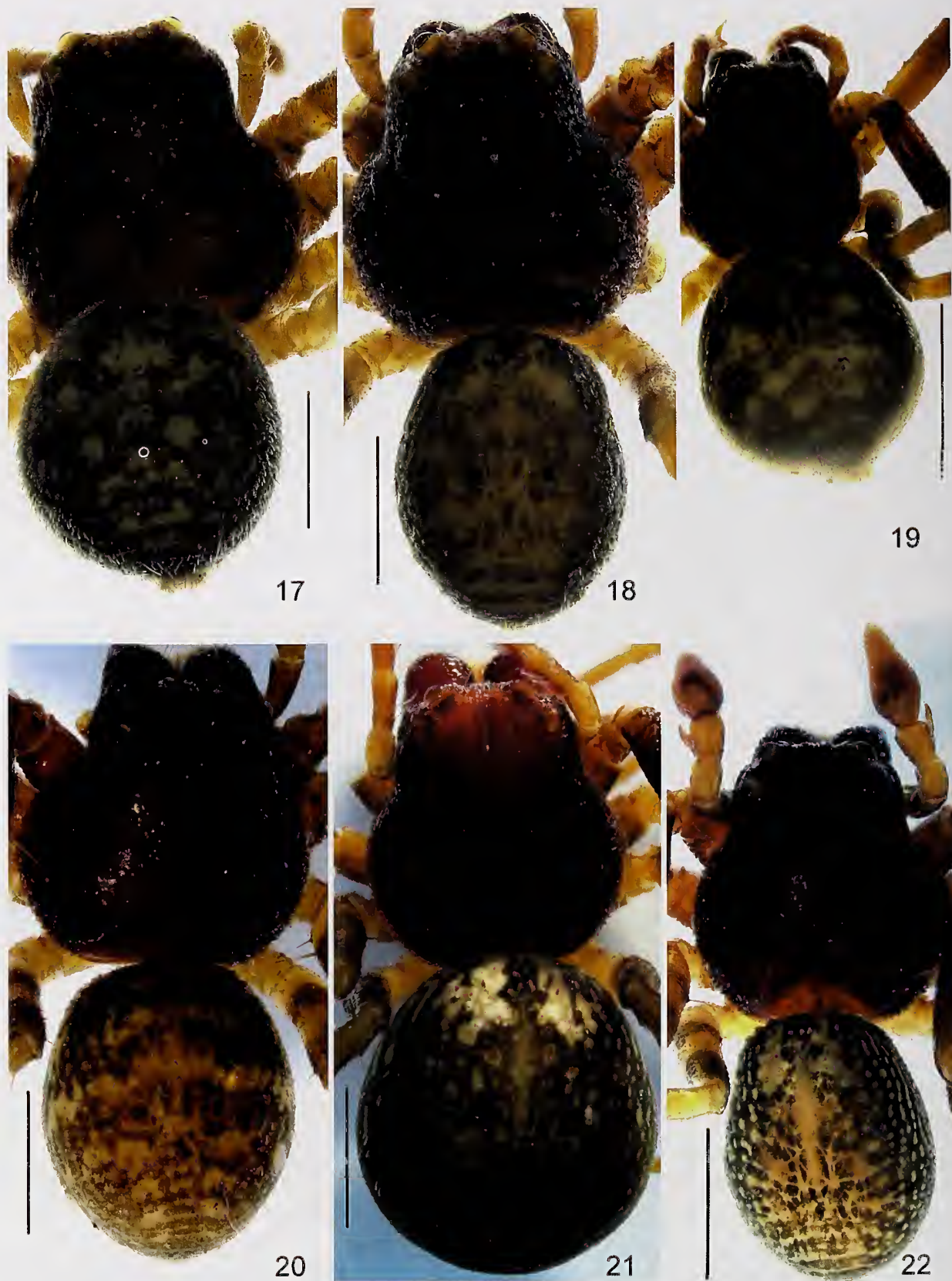
Figs 20-21, 23-26, 27-29, 32

Cupa kalawitana Barrion & Litsinger, 1995: 208, fig. 119a-f.

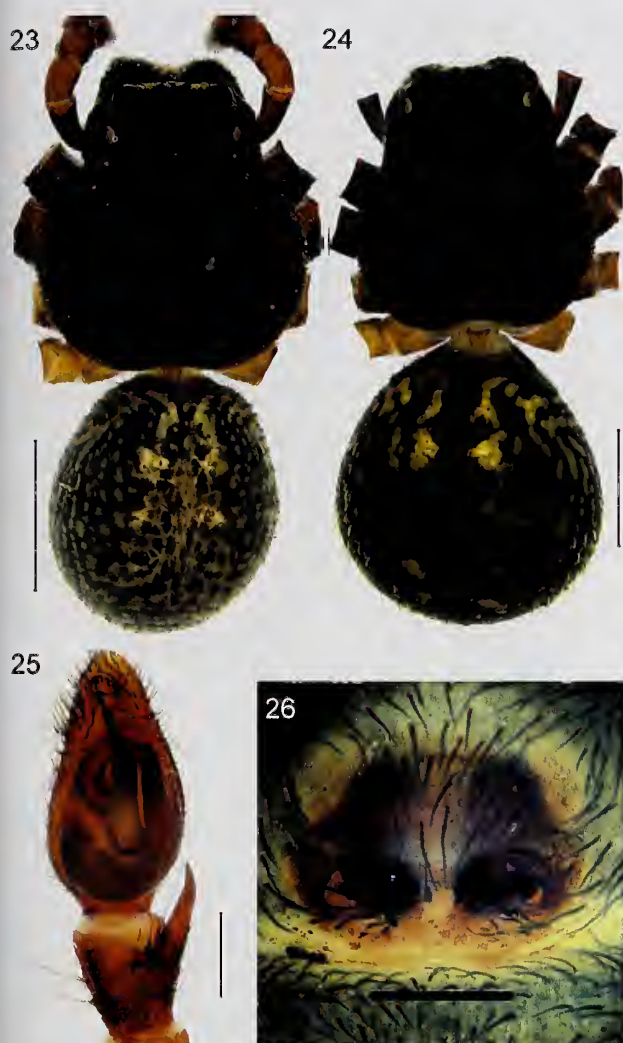
Type not examined.

Cebrenninus rugosus.— Tang *et al.*, 2009. Misidentification.

Material examined: SMF 3636; 2 males, 2 females, 3 juveniles; Philippines, Luzon, Laguna Province, Mt Makiling; leg. Baker. – CASENT 9042005; 2 males, 1 female, 1 juvenile; Philippines, Luzon Island, Laguna Province, Malabo Camp, Mt Makiling, 3.46 km SSW of Los Baños, 673 m, 14°08.220'N 121°12.325'E, general collecting, daytime, forest; 10.-12.05.2011, leg. H. Wood *et al.* – CASENT 9045699; 2 juveniles;



Figs 17-22. Photographs of *Cebrenninus* spp., dorsal view. (17-18) Syntypes of *Libania annulata* syn. nov. (= *C. rugosus*) (MCSN, 17 female, 18 male). (19) Female syntype of *Libania scabricula* syn. nov. (= *C. rugosus*) (MCSN). (20) *Cebrenninus rugosus*, male (SMF 3645). (21-22) *C. kalawitana* comb. nov (SMF 3636). Scale lines = 1.0 mm (17-18, 20-22), 2.0 mm (19).



Figs 23–26. Photographs of *Cebrenninus kalawitana* comb. nov. from the Philippines, male (23, 25), female (24, 26). (23–24) Dorsal view of body. (25) Left palp, ventral view. (26) Epigynum, ventral view. Scale lines = 0.2 mm (25–26), 1.0 mm (23–24).

Philippines, Luzon Island, Laguna Province, same locality as above, hand sorting, sifted litter in forest. – CASENT 9043491; 1 male; Philippines, Luzon Island, Laguna Province, Mt Makiling, 3.8 km WSW of Los Baños, 818 m, 14°08'20.1"N 121°11'55.0"E, general collecting, night time; 11.05.2011, leg. H. Wood *et al.* – CASENT 9047524; 1 male; Philippines, Luzon Island, Quezon Province, Mt Banahaw de Lueban, 3.78 km WSW of Lucban, 747 m, 14°05.859"N 121°31.071"E, general collecting, daytime, forest; 14.–22.05.2011, leg. H. Wood *et al.* – CASENT 9047526; 1 male, 1 female; same locality and collection data as above.

Diagnosis: Distinguished from other known congeners by distinctive shape of E (broad based, filiform, tapered towards the tip; Figs 27, 32), C (curved margins, hooked tip; Figs 27–28) and RTA (smooth, gradual tip; Figs 27,

29, 32). Females can be separated on the basis of their oval CO (Fig. 26).

Description: *Male:* Total length: 3.6; prosoma length: 1.8, width: 1.7. Leg I: femur 2.3, patella 1.5, tibia 2.3, metatarsus 1.6, tarsus 0.9. Prosoma uniformly red-brown, rounded, with eight eyes (Figs 22–23). Opisthosoma dorsally with irregular black, diffused spots, anteriorly with white spots, two pairs of brown circular spots towards the center (Figs 22–23). Laterally the black spots connect to form bands (Figs 22–23). Legs uniformly yellow-brown. Leg formula 1243, ALE > PLE > AME > PME, PME less than 0.25 times PLE. In some specimens PME reduced to two black spots. AER and PER recurved, eyes on light brown-colored mounds, mounds not touching. Palps as in Figs 25, 27–29, 32. Cymbium lacking trichobothria. The male of this species was described in detail by Barrion & Litsinger (1995).

Female: Total length: 4.3; prosoma length: 2.1, width: 1.8. Leg I: femur 2.2, patella 1.5, tibia 2.0, metatarsus 1.3, tarsus 1.0. In general similar to male (Figs 21, 24). Epigynum as in Fig. 26.

Distribution: Known only from two mountains on Luzon Island, the Philippines.

Remarks: *Cupa kalawitana* is here removed from the synonymy of *C. rugosus*, proposed by Tang *et al.* (2009). Types have not been seen, however, most of the examined material is from localities very close to the type locality. All examined material could be clearly distinguished from *C. rugosus*, as given in the diagnosis below, and are thus not considered conspecific with it.

Cebrenninus magnus sp. nov.

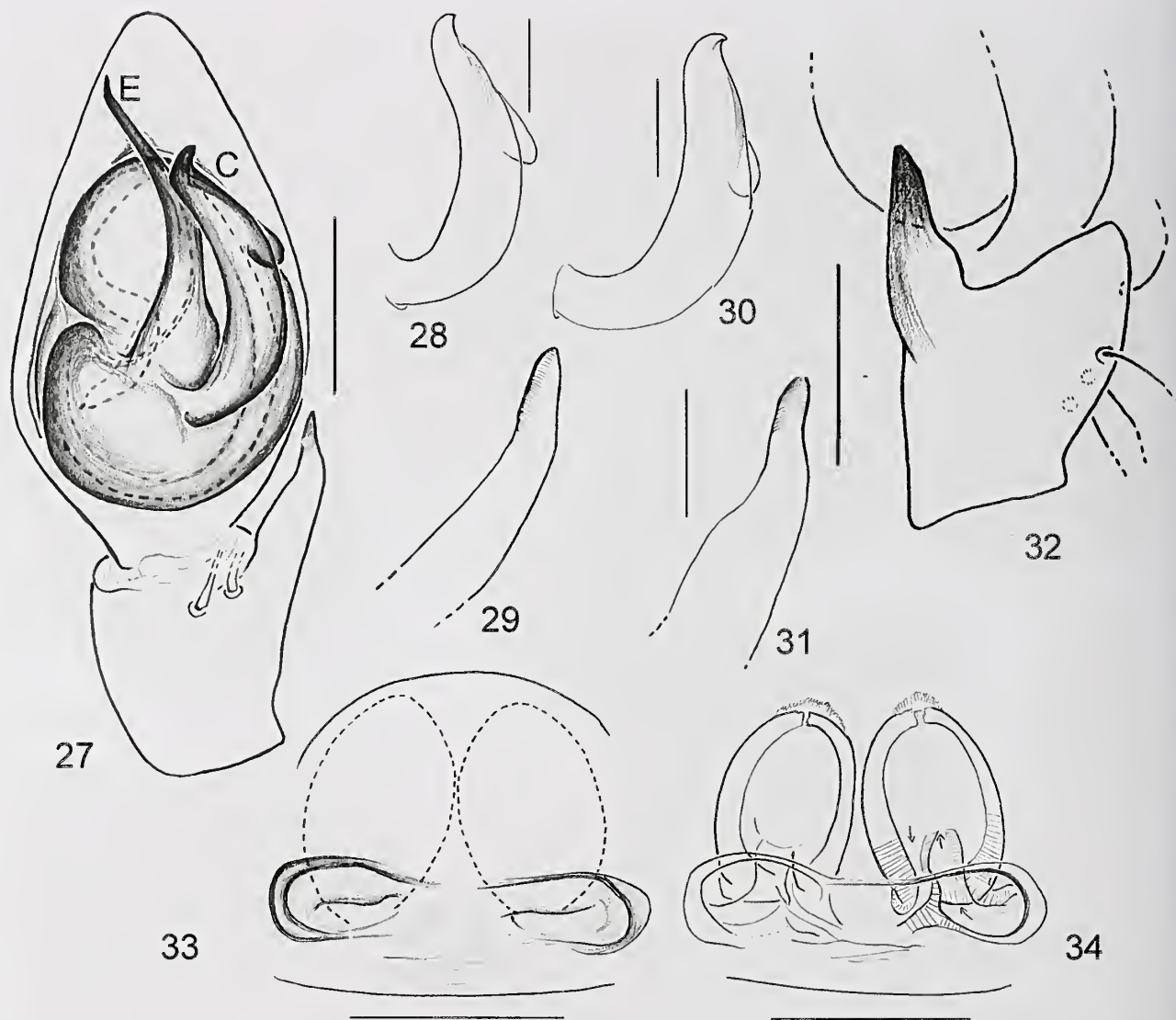
Figs 6–8, 35–36, 38–45

Cebrenninus rugosus. – Tang & Li, 2010a: 23, figs 17a–c, 18a–e, 19a–d. Misidentification.

Cebrenninus rugosus. – Benjamin, 2011: figs 8b, e–f, 27a–b, d–e, 28a–f, 29a–f. Misidentification.

Holotype: MHNG; male; Laos, Champasak Province, Bolaven Plateau, NW of Pakxong, Tham Champee, 15°12'04"N 106°08'07"E, 980 m, secondary forest near stream; 2.10.2010, leg. P. Schwendinger (sample LT-10/25).

Other material examined: CAS; 2 females; Thailand, southern Isan Region, Khao Yai National Park, 750 m, 26.07.1962; leg. E. S. Ross and D. Q. Cavagnaro. – RMNH.ARA.1594; 1 female; Nakhon Ratchasima Province, Khao Yai National Park, 800 m, 4.11.1987, evergreen forest; leg. C. L. and P. R. Deeelman. – RMNH.ARA.17168; 1 female; Nakhon Ratchasima Province, Khao Yai National Park, 800 m, under bark, killed 19.11.1987; 6.11.1987, leg. C. L. and P. R. Deeelman. – MHNG; 1 male; Chiang Mai Province,



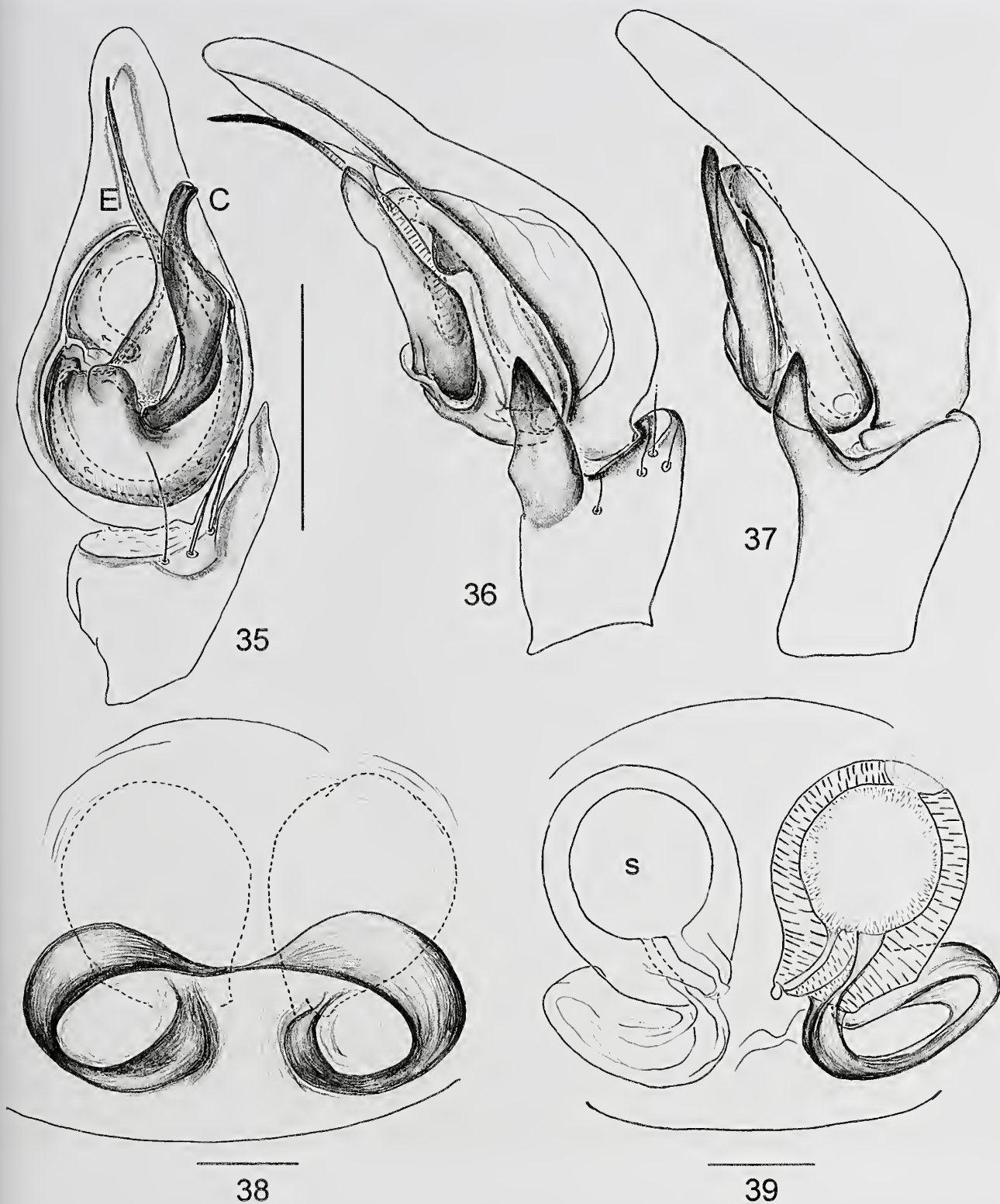
Figs 27-34. (27-29, 32) *Cebrenninus kalawitana* comb. nov from the Philippines. (30-31, 33-34) *C. berau* sp. nov., male from Indonesia, Berau District. (27-32) Left male palp. (28, 30) Conductor. (29, 31-32) RTA. (33) Female epigynum. (34) Vulva. (27-31, 33-34) Ventral view. (32) Retrolateral view. Scale lines = 0.1 mm (28-31), 0.2 mm (27, 32-34).

near Chiang Mai, Doi Suthep, 1150 m; 30.11.1996, leg. P. Schwendinger. – MHNG; 1 male, 1 female; Chumphon Province, near border between Lang Suan and Phato Districts, Khao Kai Jae Waterfall, 80 m, semi-evergreen rainforest; 21.-22.08.2004, leg. P. Schwendinger. – MHNG; 1 female; Chiang Mai Province & District, near Chiang Mai, Doi Suthep, below Tham Rüsie, 18°48'18"N 98°55'02"E, 1190 m, evergreen hill forest; 31.01.2011, leg. P. Schwendinger (sample THMY-10/10). – MHNG; 1 male, 1 female; Phetchabun Province & District, Tad Mok National Park, near Tad Mok Waterfall, 16°22'02"N 101°23'02"E, 900 m, evergreen gallery forest on earth banks; 25.12.2013, leg. P. Schwendinger (sample TH-13-14/03). – RMNH.ARA.15940; 1 male; Indonesia, Java, West Java, Puncak Pass, 1500-1600 m; leg. P. Beron and

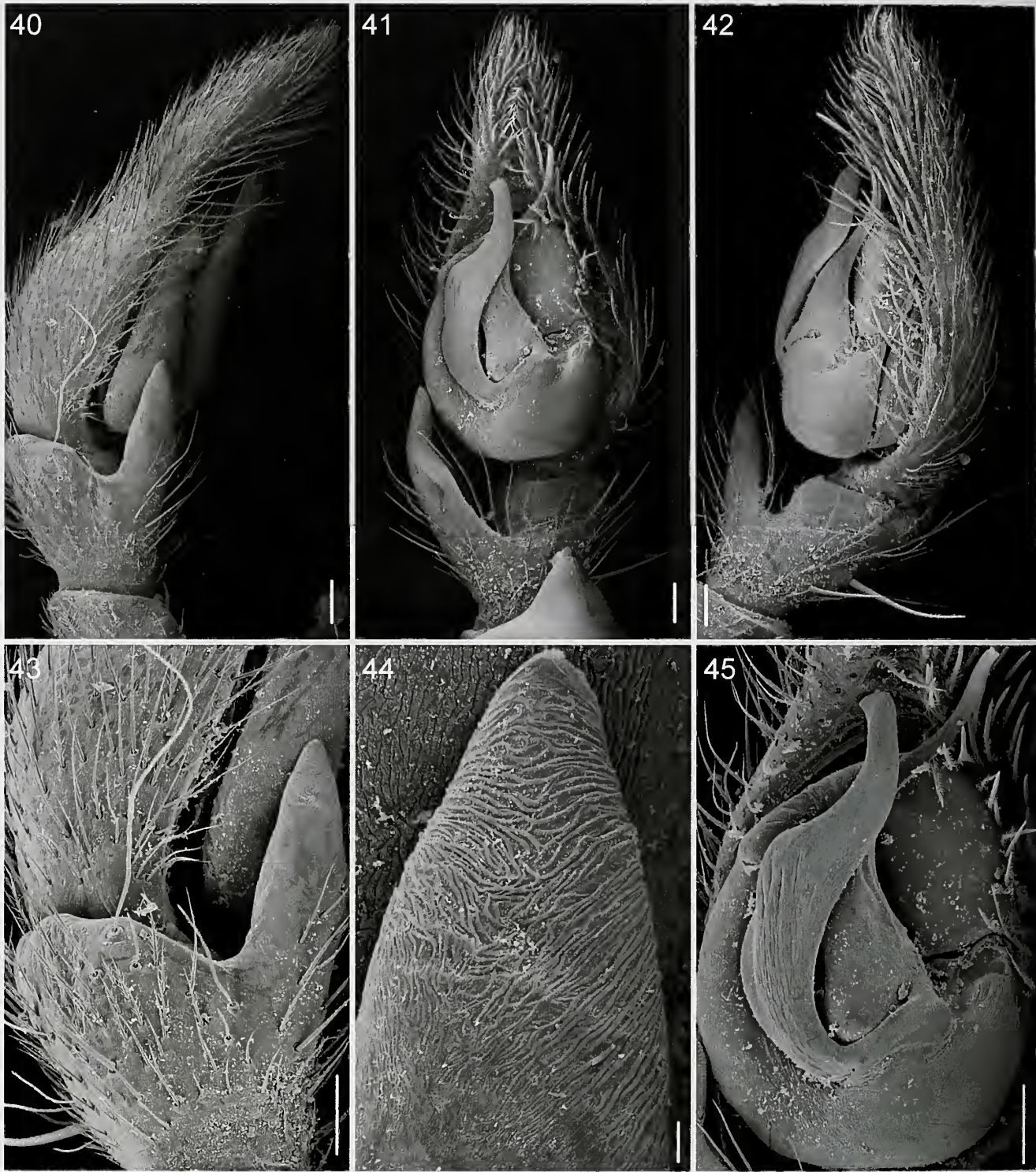
V. Beshkov, no more label data. – RMNH.ARA.15924; 1 male; E-Malaysia, Borneo, West Sarawak, Bako National Park, rain forest, 1.7167°N, 110.4667°E, on slope; leg. C. L. and P. R. Deeelman. – RMNH.ARA.17169; 1 subadult female; E-Malaysia, Borneo, West Sarawak, Semenggoh Arboretum, walking on bark; 10.01.1984, leg. C. L. and P. R. Deeelman.

Diagnosis: Distinguished from known congeners by the larger size (length: 4.7-5.3) and by the distinctive shape of E (filiform; fine tapered tip; Figs 35, 45), C (broadest approximately at the center, apical half curved, slightly broader at the tip; Figs 35-36, 41, 45) and RTA (Figs 35-36, 44). Females can be distinguished by the round CO and S (Figs 38-39).

Etymology: The specific name refers to the size of the spiders.



Figs 35-39. (35-36, 38-39) *Cebrenninus magnus* sp. nov. (37) *C. rugosus* (lectotype). (35-36) Male from Thailand (MHNG), left palp (35 ventral, 36 retrolateral view). (37) Male palp, retrolateral view. (38-39) Female from Thailand. (38) Epigynum, ventral view. (39) Vulva, dorsal view. Scale lines = 0.1 mm (38-39), 0.2 mm (37), 0.5 mm (35-36).

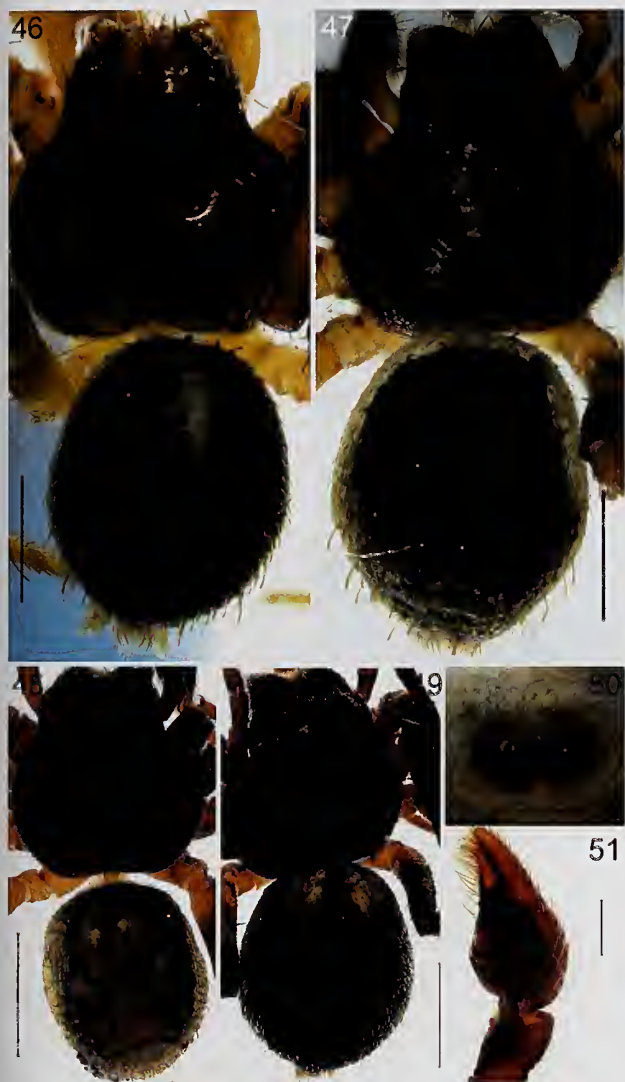


Figs 40-45. Scanning electron micrographs of *Cebrenninus magnus* sp. nov., male from Sumatra (MHNG), right male palp. (40, 43-44) Retrolateral view. (41, 45) Ventral view. (42) Prolateral view. Scale lines = 10 μ m (44), 100 μ m (40-43, 45).

Description: *Male:* Total length: 4.7-5.3; prosoma length: 2.2-3.1, width: 2.0-2.4. Leg I: femur 3.3, patella 1.0, tibia 3.3, metatarsus 2.3, tarsus 1.3. This species was described in detail by Tang & Li (2010a) and Benjamin (2011) under *C. rugosus* and thus is not dealt further here.

Distribution: Known from localities in China (Tang & Li, 2010a), Laos, Thailand, on Java and western Borneo.

Natural history: Probably a bark dweller; often collected on or under bark.



Figs 46-51. (46-47, 50) Photographs of *Cebrenninus phaedrae* sp. nov. (48-49, 51) Photographs of *C. schawalleri* sp. nov. (46, 48, 51) Male. (47, 49-50) Female. (46-49) Dorsal view. (50) Ventral view. (51) Retrolateral view. Scale lines = 0.2 mm (50-51), 0.5 mm (46-47), 1.0 mm (48-49).

***Cebrenninus phaedrae* sp. nov.**

Figs 46-47, 50, 52-56

Holotype: RMNH.ARA.159411; male; Indonesia, Borneo, Central Kalimantan, 40 km N of Palang Karaya, 2°12'36"S 113°55'2"E, secondary forest, litter; 09.1985, leg. Suharto Djojosedharmo.

Other material examined: RMNH.ARA.15942; 4 males, 10 females; Indonesia, Central Kalimantan, Kaharian, 20°2'S, 113°40'E; coll. Deeleman, no more label data. – RMNH.ARA.17170; 5 males, 4 females, 6 juveniles; Indonesia, West Sumatra, Rimba Panti Nature Reserve, lowland primary rainforest, leaf litter on mineral soil; 3.08.1982, leg. C. L. and P. R. Deeleman. – RMNH.ARA.17171; 1 male, 2 females; Indonesia, Central Kalimantan, Kaharian, 20°2' S, 113°40' E,

swampy primary forest, leaf litter; 2.-16.09.1985, leg. Suharto Djojosedharmo. – RMNH.ARA.17172; 1 female; Indonesia, Borneo, West Sarawak, Semerghoh Arboretum, litter; 1984, leg. C. L. and P. R. Deeleman. – RMNH.ARA.15935; 2 males, 3 females; same locality; 23.03.1985, leg. C. L. and P. R. Deeleman. – RMNH.ARA.17173; 3 males, 7 females, 3 juveniles; Indonesia, North Sumatra, Gunung Leuser, Ketambe, lowland leaf litter trail 1.1; 7.07.1985, leg. Suharto Djojosedharmo. – RMNH.ARA.17174; 4 males, 17 females; same data as above, tr.8.4; 02.08.1985. – RMNH.ARA.17175; 20 males, 31 females, 10 juveniles; same data as above; 1.05.- 9.08.1985, lowland leaf litter; in addition to the above listed specimens, this sample contained several specimens of *C. berau* sp. nov. – RMNH.ARA.17176; 26 males, 38 females; same data as above; 24.03.1986; in addition to the above listed specimens, this sample contained several specimens of *C. berau* sp. nov. – RMNH.ARA.17177; 1 male; same locality, trail 2.4, leaf litter; 4.05.1986, leg. Suharto Djojosedharmo. – RMNH.ARA.15936; 2 males, 1 female; Peninsular Malaysia, Klang Valley, Selangor, Templer's Park, 03°17.60'N 101°39.25'E, litter; 19.03.1985, leg. C. L. and P. R. Deeleman. – RMNH.ARA.17178; 2 females; Peninsular Malaysia, Klang Valley, Selangor, Templer's Park, 03°17.60'N 101°39.25'E, leaf litter; 29.07.1980, leg. C. L. and P. R. Deeleman.

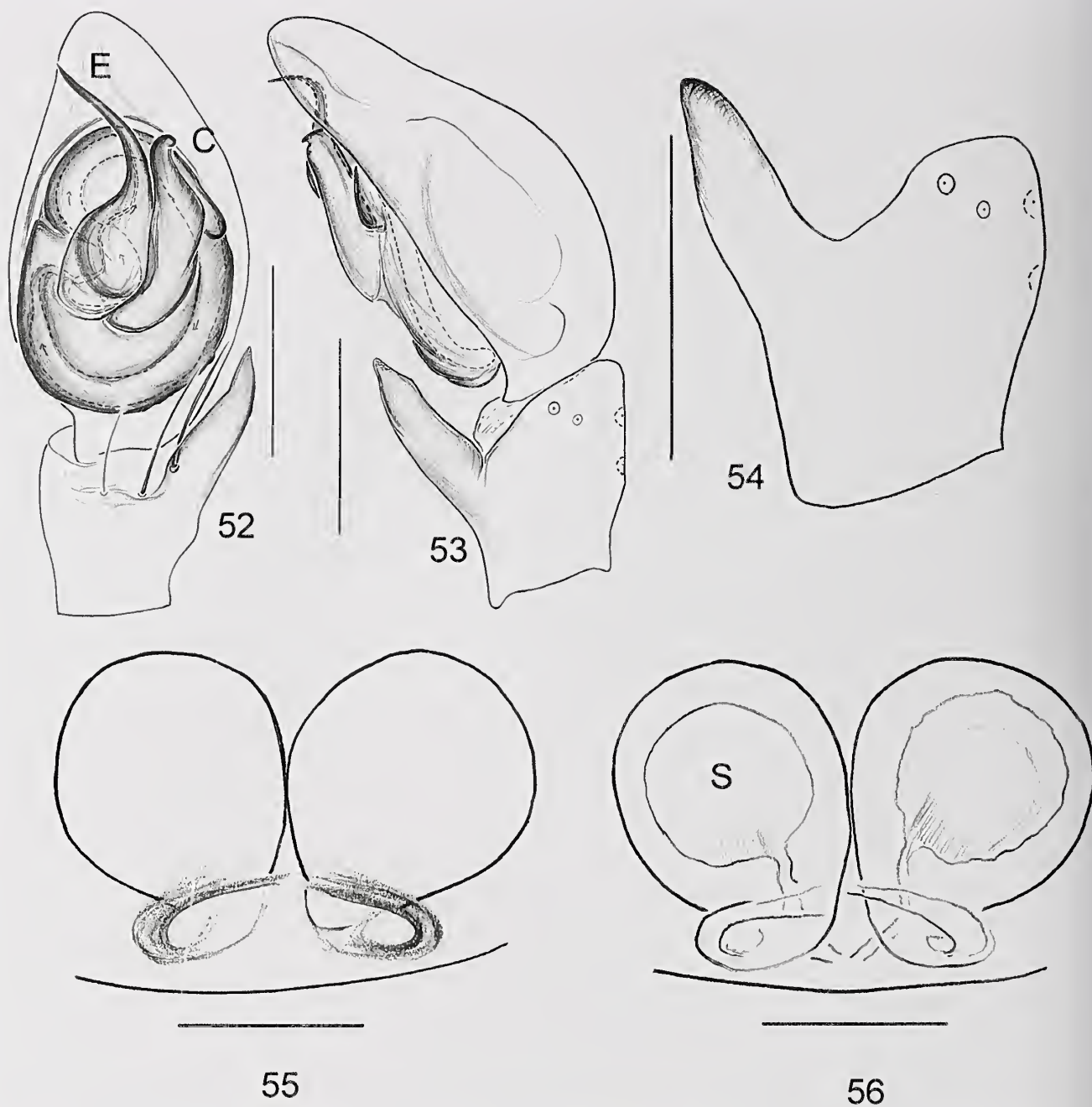
Diagnosis: Similar to *C. berau* sp. nov., distinguished from this and other known congeners by distinctive shape of E (posterior half bottle-shaped, anterior half filiform, tip pointed; Figs 52-53), C (straight prolateral margin, broadest at midpoint, hooked tip; Figs 52-53) and RTA (tapering, pointed tip; Figs 52-54). Females can be distinguished by the round spermathecae, and by short CD not being longer than the width of the wall of S (Figs 55-56). Specimens of both sexes are smaller and lighter in color than specimens of *C. berau* sp. nov.

Etymology: Named after the ancient Greek mythological figure Phaidra.

Description: *Male:* Total length: 2.5; prosoma length: 1.4, width: 1.1. Leg I: femur 1.2, patella 0.3, tibia 1.0, metatarsus 0.7, tarsus 0.5. Prosoma red-brown, rounded, six eyes, PME absent, LE on light brown-colored mounds, mounds distinct but not touching (Fig. 46). Opisthosoma dorsally with irregular black diffused spots, two pairs of brown circular spots towards center, laterally black spots connected to form bands (Fig. 46). Legs uniformly yellow-brown. Leg formula 1243, ALE > PLE > PME. AER and PER recurved. Palps as in Figs 52-54. Cymbium without trichobothria.

Female: Total length: 2.3; prosoma length: 1.2, width: 1.1. Leg I: femur 1.0, patella 0.3, tibia 1.0, metatarsus 0.7, tarsus 0.5. In general similar to male. Epigynum and vulva as in Figs 55-56. Spermathecae rounded, CD short.

Distribution: Known from localities on Borneo, Sumatra and Peninsular Malaysia.



Figs 52-56. *Cebrenninus phaedrae* sp. nov. (52, 54) Male from Malaysia (RMNH.ARA.15936). (53) Male from Indonesia (RMNH.ARA.15941). (55-56) Female from Indonesia (RMNH.ARA.15942). (52-54) Male palp (52 ventral, 53-54 retrolateral view). (55) Epigynum, ventral view. (56) Vulva, ventral view. Scale lines = 0.1 mm (55-56), 0.2 mm (52-54).

***Cebrenninus rugosus* Simon, 1887**

Figs 17-20, 57-64

Cebrenninus rugosus Simon, 1887: 468. – Simon, 1897: 9, figs 1-2. – Tang *et al.*, 2009: 40, figs 1a-f. Misidentification. – Tang & Li, 2010a: 23, figs 17a-c, 18a-e, 19a-d. Misidentification. – Benjamin, 2011: figs 8b, e-f, 27a, b, d-e, 28a-f, 29a-f. Misidentification. – Benjamin, 2011: figs 5c, 5f, 27c. – Ramírez, 2014: 223, fig. 151D. Misidentification.

Libania scabricula Thorell, 1890: 148. **Syn. nov.**

Libania scabricula sulcata Thorell, 1890: 148. **Syn. nov.**

Libania annulata Thorell, 1890: 149. **Syn. nov.**

Libania armillata Thorell, 1890: 149.

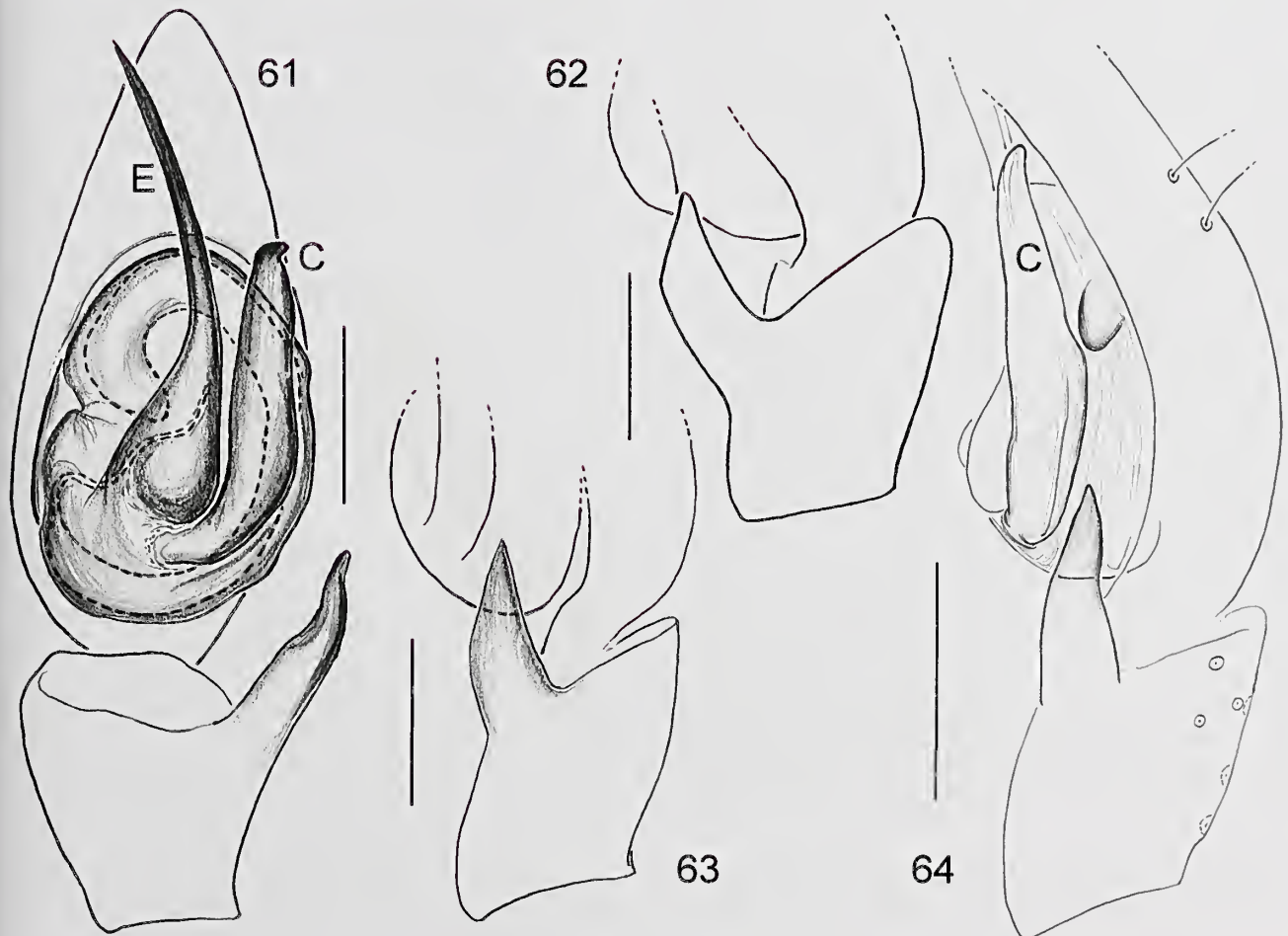
Type material: MNHN 8652/1572; male lectotype (examined); no locality data given. – MCSN; 2 female syntypes of *Libania scabricula* Thorell, 1890 (examined); Cibodas, Java, Indonesia; X.1873, O. Beccari. – MCSN; 2 females, 1 male, 1 juvenile syntypes of *Libania annulata* Thorell, 1890 syn. nov. (examined); Sumatra, Singalang; VII.1878, O. Beccari.

Other material examined: SMF 3645; 7 males;



Figs 57-60. Photographs of *Cebrenninus rugosus*. (57, 59) Syntypes of *Libania annulata* syn. nov. (MCSN, 57 left male palp, ventral view, 59 epigynum, ventral view). (58) *C. rugosus*, male from Indonesia, left male palp, retrolateral view (SMF 3645). (60) Syntype of *Libania scabricula* syn. nov., epigynum, ventral view (MCSN). Scale lines = 0.2 mm.

Figs 61-64. *Cebrenninus rugosus*, left palp. (61-62) Male from Indonesia (SMF 3645). (63) Syntype of *Libania annulata* syn. nov. (MCSN). (64) Male from Indonesia (RMNH.ARA.15939). (61) Palp, ventral view. (62-63) RTA, retrolateral view. (64) Palp, retrolateral view. Scale lines = 0.2 mm.



Indonesia, Sumatra, west coast, Gunung Singgalang, 1800 m; 1925, leg. E. Jacobson. – RMNH.ARA.15939; 1 male, 1 female, several juveniles; Indonesia, East Sumatra, Gunung Leuser N.P., Bohorok, 3°30'0"N, 97°30'0"E, leaf litter, 10.08.1982, leg. C. L. and P. R. Deeleman. – MHNG; 1 male, 1 female; Indonesia, South Kalimantan Province, Pagat, ca 6 km E of Barabai, Gunung Batu Benawa, 2°38'40"S, 115°24'46"E, 110 m, secondary forest on lime stone; 11.-14.10.2008, leg. P. Schwendinger (sample IND-08/18).

Remarks on synonymy: Type material of *Libania scabricula* and *L. annulata* unambiguously match the type of *C. rugosus*. The type of *Libania scabricula sulcata* is lost; however, it is considered similar to *L. scabricula* based on the original description and thus is here placed in the synonymy of *C. rugosus*. Some of the examined material is from the type locality of *L. annulata*, i.e. Sumatra, Singalang (= Gunung Singgalang). All of it unambiguously matches the type of *C. rugosus*. The synonymization of *L. armillata* is by Roewer (1954) and is followed here. Furthermore, as Mt Singgalang is very rich in species, all these synonymies should be further assessed when more material from that region becomes available.

Diagnosis: Distinguished from known congeners by the presence of two dorsal trichobothria on the cymbium, distinctive shape of E (filiform; oval base, tapering to a fine tip; Figs 57, 61), C (broadest just above base, partly straight retrolateral margin, hooked tip; Figs 57-58, 61, 64) and RTA (inward turn approximately at midpoint, pointed tip; Figs 57-58, 61-64). Females can be distinguished by the round CO and S (Figs 59-60).

Description: *Male* from Gunung Singgalang (SMF 3645): Total length: 4.3-4.6; prosoma length: 2.1, width: 2.0. Leg I: femur 2.2, patella 0.7, tibia 2.2, metatarsus 1.3, tarsus 0.9. Prosoma uniformly red-brown, eight eyes (Figs 17-20). Opisthosoma dorsally with irregular black, diffused spots, anteriorly with white spots, two pairs of brown circular spots towards the center, laterally black spots connect to form bands (Figs 17-20). Legs uniformly yellow-brown. Leg formula 1243, ALE > PLE > AME > PME (AME 0.5 times ALE). AER and PER recurved, eyes on light brown-colored mounds, mounds of LE not touching. Palps as in Figs 61-64. Cymbium of male palp with two dorsal trichobothria (Fig. 64).

Female: Total length: 3.0; prosoma length: 1.5, width: 1.4. Leg I: femur 1.2, patella 0.5, tibia 1.2, metatarsus 0.9, tarsus 0.6. In general similar to male. ALE > PLE > AME, PME absent. Epigynum and vulva as in Figs 59-60.

Distribution: Known from localities on Sumatra and Borneo.

Cebrenninus schawalleri sp. nov.

Figs 48-49, 51, 65-69

Holotype: SMF; male; Philippines, Leyte, Visca, North Baybay, primary forest, 200-500 m; leg. W. Schawaller *et al.*, 22.02.1991.

Other material examined: SMF; 1 male collected together with the holotype. – SMF; 2 females; Philippines, Leyte, Lake Danao, forest edge, 500 m; leg. W. Schawaller *et al.*, 19.02.1991.

Diagnosis: Similar to *C. rugosus*, distinguished from this and other known congeners by distinctive shape of E (broad, lateral projection just below curved, hook-like tip; Figs 65-66), C (curved retrolateral margin, stout hooked tip; Figs 65-66) and RTA (tip beak-shaped; Figs 66-67). Females can be distinguished by the elongated/oval spermathecae (Figs 68-69).

Etymology: Named after the collector.

Description: *Male:* Total length: 3.6; prosoma length: 1.7, width: 1.7. Leg I: femur 2.1, patella 0.7, tibia 2.0, metatarsus 1.0, tarsus 0.7. Opisthosoma dorsally with irregular black, diffused spots, anteriorly with white spots, two pairs of brown circular spots towards the center, laterally black spots connecting to form bands (Figs 48-49). Legs uniformly yellow-brown. Leg formula 1243, ALE > PLE > AME > PME, PME reduced, barely visible, PME less than 0.25 times PLE. AER and PER recurved, eyes on light brown-colored mounds, mounds of LE not touching. Palps as in Figs 51, 65-67. Cymbium lacking dorsal trichobothria.

Female: Total length: 3.8; prosoma length: 1.8, width: 1.8. Leg I: femur 2.0, patella 0.7, tibia 1.8, metatarsus 1.3, tarsus 0.9. In general similar to male. Epigynum and vulva as in Figs 68-69.

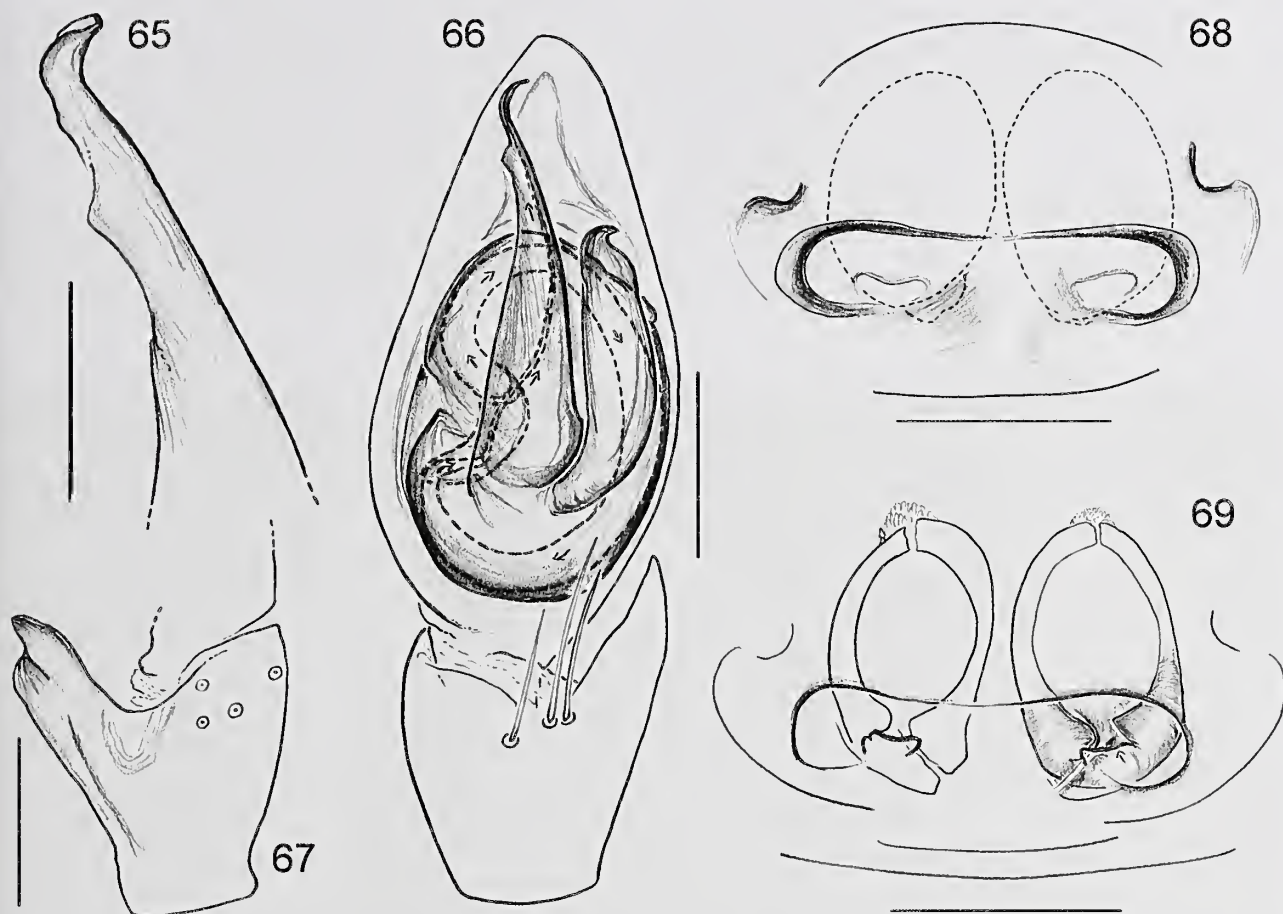
Distribution: Philippines, Leyte.

Cebrenninus srivijaya Benjamin, 2011

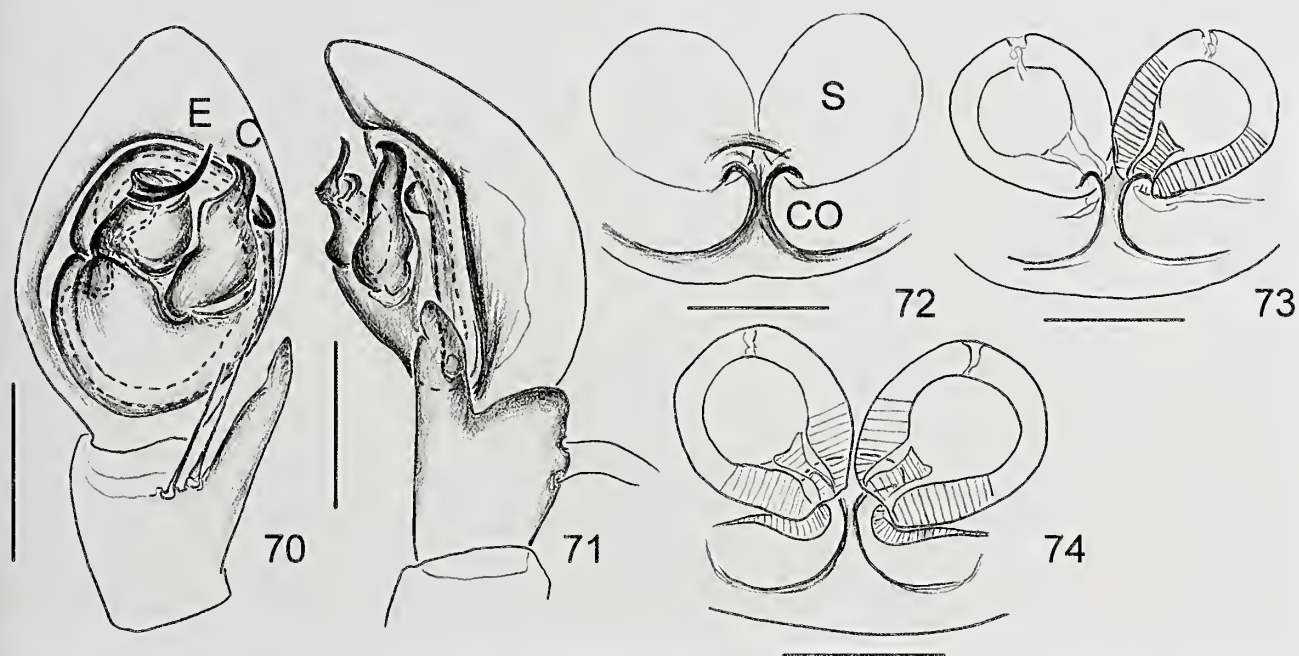
Figs 70-80

Cebrenninus srivijaya Benjamin, 2011: 13, figs 6d, 30a-e, 31a-f, 32a-f.

Material examined: RMNH.ARA.15931; 11 males, 23 females; Indonesia, Sumatra, Mt Singgalang, 400-520 m, secondary forest, leaf litter; 7.-4.07.1994, leg. Suharto Djojosedharmo; collection Deeleman. – RMNH.ARA.17179; 2 males, 2 females; same data as previous sample; 7.-24.06.1994. – RMNH.ARA.15932; 29 males, 27 females; Indonesia, Sumatra, Kerinci Seblat National Park, 2°25'S 101°29'E, 800 m, nr. river, leaf litter; 21.-30.07.1988, leg. Suharto Djojosedharmo, collection Deeleman. – RMNH.ARA.17180; 1 female, 1 juvenile; Indonesia, N. Sumatra, Gunung Leuser, Ketambe, litter; 26.06.1985, leg. Suharto Djojosedharmo, (with label: 6 eyed "Hedenna").



Figs 65-69. *Cebrenninus schawalleri* sp. nov. (65) Tip of embolus. (66) Male palp. (67) RTA, retrolateral view. (68) Epigynum, dorsal view. (69) Vulva. (65-66, 69) Ventral view. Scale lines = 0.1 mm (65), 0.2 mm (66-69).



Figs 70-74. *Cebrenninus srivijaya*, male holotype and female paratype from Sumatra (MHNG). (70-71) Male palp (70 ventral, 71 retrolateral view). (72) Epigynum, ventral view. (73-74) Vulva (73 ventral, 74 dorsal view). Scale lines = 0.1 mm (72-74), 0.2 mm (70-71).

Diagnosis: Similar to *C. berau* sp. nov. and *C. phaedrae* sp. nov., distinguished from these and other known congeners by distinctive shape of E (posterior half cylindrical, anterior half filiform, partly surrounding its base; Figs 70-71, 75, 78), C (posterior half broad, anterior half a stout hook; Figs 70-71, 75, 79) and RTA (pointed, ventrally slanted tip; Figs 71, 76).

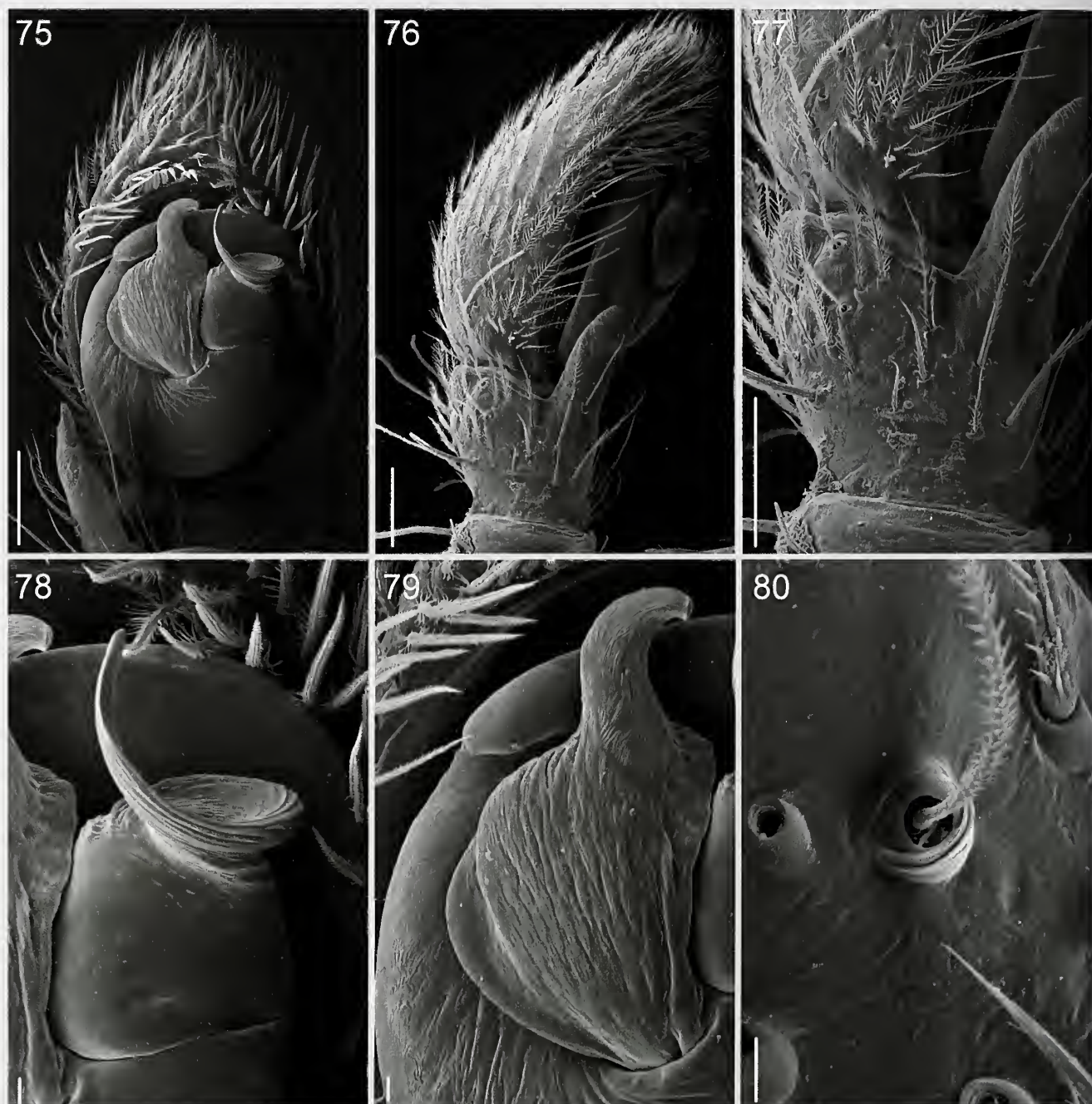
***Cebrenninus striatipes* (Simon, 1897) comb. nov.**

Figs 81-91

Ascuris striatipes Simon, 1897: 9.

Ascurisoma striatipes (Simon, 1897). – Strand, 1929: 14 (generic replacement name).

Type material: MNHN 17268; 1 female, 3 juvenile syntypes (examined); Sri Lanka, Central Province, Kandy (no more data given). – MNHN 11680; 1 juvenile



Figs 75-80. Scanning electron micrographs of *Cebrenninus srivijaya*, right palp of male paratype from Sumatra (MHNG). (75) Bulbus, ventral view. (76) Palp, retrolateral view. (77) Tibial trichobothria, retrolateral view. (78) Embolus, ventral view. (79) Conductor, ventral view. (80) macro-trichobothrium on palpal tibia, retrolateral view. Scale lines = 10 μ m (75-77), 100 μ m (78-80).

syntype? (examined); Africa, Sierra Leone (no more data given). The adult female from Sri Lanka is here designated as the lectotype to clearly define the genus.

Other material examined: MHNG; 1 male, 2 females; Sri Lanka, Central Province, Kandy District, Knuckles Range, Corbett's Gap, 7°23'39"N, 80°51'38"E, 1360 m; 19.08.2010, leg. S. P. Benjamin and S. Batuwita. All three specimens were collected as juveniles and reared to adulthood in the lab. The final molt of the male was on 16.10.2010 and of one female on 30.10.2010.

Remarks: The juvenile from Sierra Leone looks very much like the specimens from Sri Lanka. However, the validity of a taxon or its presence in a given locality cannot be based on a juvenile specimen. I doubt the presence of *C. striatipes* comb. nov. in Sierra Leone; this specimen might belong to a yet unknown species of the genus *Geraesta* Simon, 1889.

Diagnosis: Distinguished from known congeners by the distinctive shape of E (broad, thickest in the upper half, stout tip; Figs 86-87) and C (reduced, fine tip; Fig. 86).

Description: *Male:* Total length: 2.9; prosoma length: 1.4, width: 1.4. Leg I: femur 1.4, patella 0.5, tibia 1.4, metatarsus 0.8, tarsus 0.6. Prosoma uniformly black (red-brown in preserved specimens), eight eyes surrounded by red patches (Figs 81-82). Opisthosoma dorsally brown/black with irregular white, diffused spots, white spots very apparent in preserved specimens (Fig. 85). Legs black with yellow-brown patches, clearly visible on femur I and II. Leg formula 1243. Palps as in Figs 86-87. Tibia shorter than bulb, bulb oval, RTA well developed, with two large setae at its base. E broad, thickest in upper half, with stout tip (Figs 86-87). C reduced, with fine tip. SDT with two turns (Figs 86-87).

Female: Total length: 4.1; prosoma length: 1.7, width: 1.8. Leg I: femur 1.6, patella 0.7, tibia 1.6, metatarsus 1.0, tarsus 0.6. In general similar to male (Figs 83-84). Epigynum as in Figs 88-91.

Distribution: Known only from the Knuckles Range, Sri Lanka.

Cebrenninus tangi sp. nov.

Cebrenninus rugosus.— Tang *et al.*, 2009: 40, fig. 1a-f. Misidentification.

Holotype: Hunan Normal University, Hu 060901; 1 male (not examined); China, Yunnan Province, Gongshan County, Dulongjiang Township, Qinglangdang, 27°41'N 98°17'E; 1.09.2006, leg. P. Hu.

Other material examined: None.

Diagnosis: Similar to *C. kalawitana* and *C. rugosus*, distinguished from both species by the presence of eight eyes (PME reduced in *C. kalawitana*) and by

shorter E and C (relatively longer in *C. kalawitana* and *C. rugosus*; Tang *et al.*, 2009: 40, fig. 1a-f cf. Figs 25, 57).

Etymology: Named after my friend Dr Guo Tang (1974-2014).

Description: See Tang *et al.* (2009). Females are unknown.

Distribution: Known only from the type locality.

Crockeria gen. nov.

Type species: *Crockeria kinabalu* sp. nov.

Etymology: The genus is named after William Maunder Crocker (1843-1899), who was an administrator in Borneo.

Diagnosis: Males of *Crockeria* gen. nov. can be distinguished from males of other Stephanopinae by the following combination of characters: presences of a stalked MA with a concave apex, presence of a sclerotized filiform C, and a broad-based filiform E. Females can be distinguished by the C-shaped CO, short CD and round S.

Remarks: *Crockeria* gen. nov. is most closely related to and likely to be confused with *Cebrenninus*, *Epidius* Thorell, 1877, *Ibana* Benjamin, 2014 and *Pharta* Thorell, 1891, known from the Oriental region. It can be separated from these genera, in addition to the characters given above, as follows: from *Cebrenninus* by the longer copulatory ducts and lack of ETP; from *Epidius* by the absence of an elongated male palpal tibia (tibia is longer than the cymbium in *Epidius*); from *Pharta* by the absence of a macro-trichobothrium on the palpal tibia, the absence of serrated tarsal setae, the absences of posterior epigynal pockets and by oval, dual-chambered spermatheca; from *Ibana* by the combined presences of a MA, C and E.

Description: See description of the type species below.

Species composition: *Crockeria kinabalu* sp. nov. and *Crockeria laevis* (Thorell, 1890) comb. nov.

Distribution: Sumatra (Mt Singgalang), Borneo (Sabah: Mt Kinabalu).

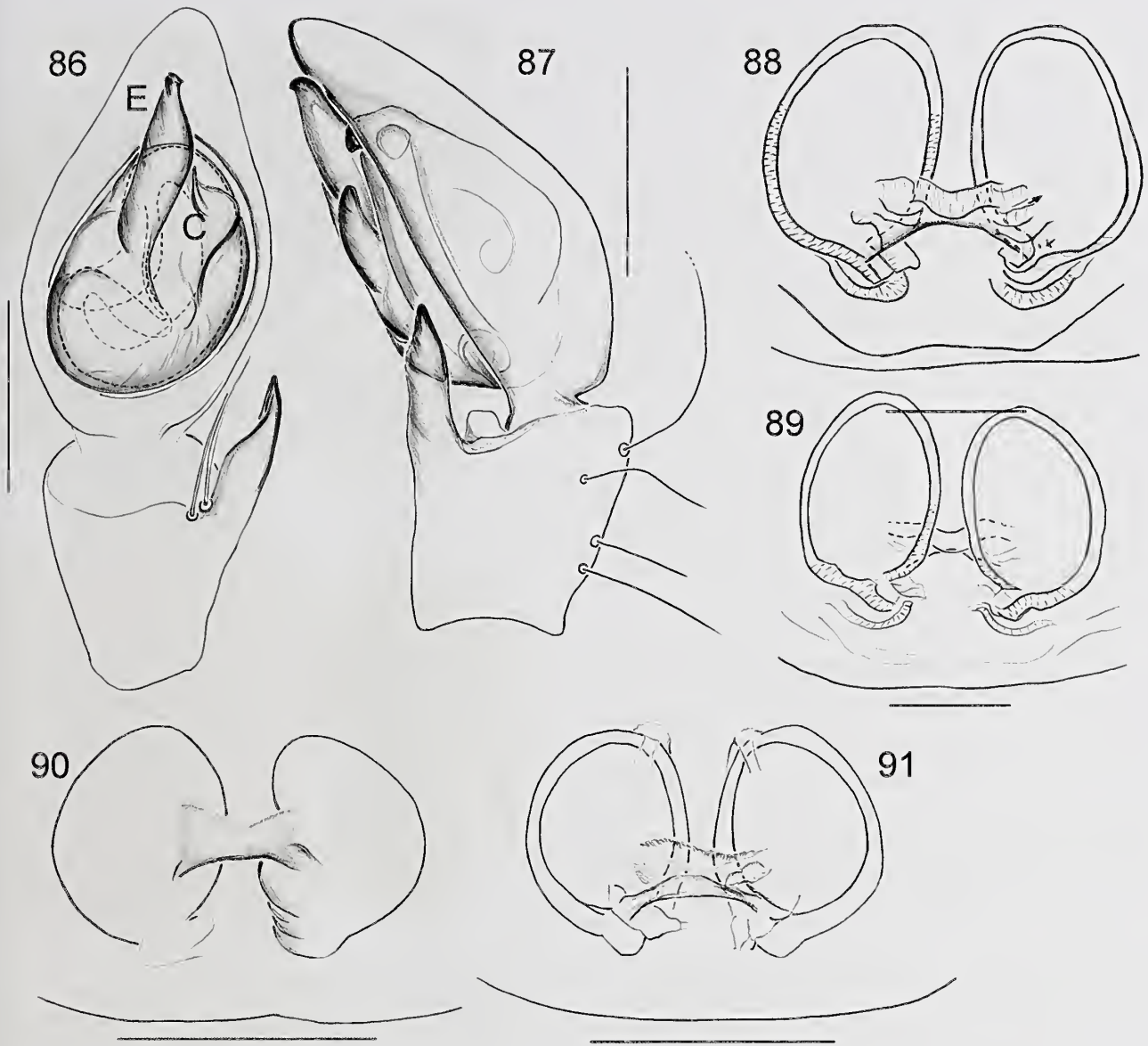
Crockeria kinabalu sp. nov.

Figs 92-93, 96-99

Holotype: RMNH.ARA.15929; male; East Malaysia, Borneo, Sabah, Mt Kinabalu National Park, 15 year old secondary forest, 500-700 m, loc 46, fogging canopy tree 8 *Vinex pinnata*, refog 1 after 8 days; 10.03.1997, leg. A. Floren.

Diagnosis: *Crockeria kinabalu* sp. nov. can be





Figs 86-91. *Cebrenninus striatipes* (Simon, 1897) comb. nov. (86-87) Male from Knuckles Range, left palp (86 ventral, 87 retrolateral view). (88) Female lectotype, epigynum, ventral view. (89) Vulva of same specimen, ventral view. (90) Female from Knuckles Range, epigynum, ventral view. (91) Vulva of same specimen, ventral view. Scale lines = 1.0 mm (88-89), 0.2 mm (86-87, 90-91).

Figs 81-85. *Cebrenninus striatipes* (Simon, 1897) comb. nov. (81-82) Male in life. (83-84) Female in life. (50) Female lectotype, dorsal view (MNHN 11680).

distinguished from the only other known species of the genus, *Crockeria laevis* (Thorell, 1890) comb. nov., by the smaller CO (Figs 98-99 cf. Fig. 95).

Etymology: The species name is a noun in apposition taken from the name of the type locality.

Description: *Male:* Total length: 3.2; prosoma length: 1.5, width: 1.3. Leg I: femur 1.3, patella 0.5, tibia 1.3, metatarsus 1.2, tarsus 0.6. Coloration and markings as in Figs 92-93, prosoma dark brown, much darker than opisthosoma. Palps as in Figs 96-97, tibia with a single apical apophysis, tip tapering; tegulum oval, MA stalked, apex concave; C sclerotized, broad-based, with filiform tip; E, filiform, shorter than C. Leg formula 1243, ALE > PLE > PME > AME. AER and PER recurved, eyes on light brown-colored mounds.

Female: Total length: 4.0; prosoma length: 1.7, width: 1.7. Leg I: femur 1.5, patella 0.7, tibia 1.6, metatarsus 1.3, tarsus 0.7. In general similar to male. Epigynum and vulva as in Figs 98-99. CO with C-shaped lateral margins, CD short and tapering, S rounded.

Other material examined: RMNH.ARA.15926; 1 male, 1 female; East Malaysia, Borneo, Sabah, Mt Kinabalu National Park, Sorinsim, 15 year old secondary forest, 500-700 m, fogging canopy tree 8 *Vinex pinnata*, refog 1 after 8 days, loc 57; 6.03.1997, leg. A. Floren. – RMNH.ARA.17181; 1 male, not well preserved, some legs missing; East Malaysia, Borneo, Sabah, Mt Kinabalu National Park, 6°05'N 116°50'E, 40 year old secondary forest, 500-700 m, fogging canopy tree 2 *Vinex pinnata*, fog 1, loc 52; 5.03.1997, leg. A. Floren.

Distribution: Known only from the type locality.

***Crockeria laevis* (Thorell, 1890) comb. nov.**

Figs 94-95

Libania laevis Thorell, 1890: 148.

Cebrenninus laevis. – Simon, 1897: 8.

Type material: MCSN; 1 female syntype of *Libania laevis* Thorell, 1890 (examined); Indonesia, Sumatra, Singalang, no more data; 8.1878; O. Beccari.

Diagnosis: This species can be distinguished from the only other known congeneric species, *Crockeria kinabalu* sp. nov., by the larger CO (Fig. 95 cf. Figs 98-99).

Description: The type is very fragile, with several legs detached, and was not measured to avoid further damage. Habitus as in Fig. 94. Coloration unclear; specimen bleached due to preservation. Epigynum as in Fig. 95. Male unknown.

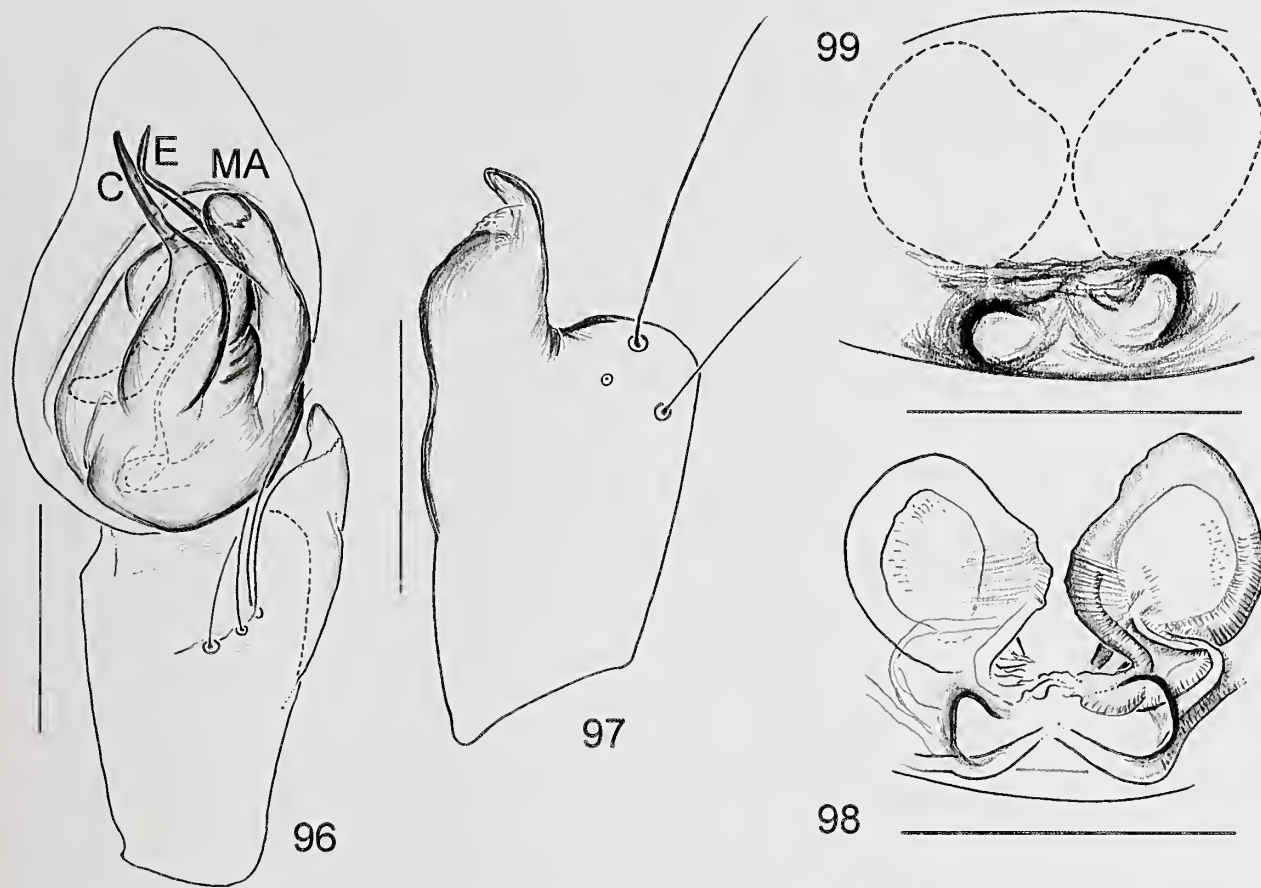
Distribution: Known only from the type locality on Sumatra.



Figs 92-95. (92-93) *Crockeria kinabalu* gen. et sp. nov. (92) Male holotype from Sabah (RMNH.ARA.15929). (93) Female from Sabah (RMNH.ARA.15926). (94-95) Syntype of *C. laevis* comb. nov. (MCSN). (92-94) Habitus, dorsal view. (95) Vulva, ventral view. Scale lines = 1.0 mm (92-94), 0.2 mm (95).

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Figs 96-99. *Crockeria kinabalu* gen. et sp. nov., male and female from Sabah (RMNH.ARA.15926). (96) Male palp, ventral view. (97) RTA, retrolateral view. (98) Epigynum, ventral view. (99) Vulva, ventral view. Scale lines = 0.2 mm.

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Otiorhynchus (Choilisanus) theophrastus sp. nov. from Lesbos Island, Greece (Coleoptera, Curculionidae, Entiminae)

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Abstract: A new species of *Otiorhynchus* Germar, 1822 of the subgenus *Choilisanus* Reitter, 1912 is described from the Aegean Island Lesbos (Greece). The new species is morphologically close to *O. (Choilisanus) magnicollis* Stierlin, 1888 from Ikaria and Samos Island, and to *O. formaneki* Reitter, 1913 from Asia Minor.

Keywords: Curculionoidea - Entiminae - *Otiorhynchus* - new species - taxonomy.

INTRODUCTION

The subgenus *Choilisanus* Reitter, 1912 comprises at present 45 species, with a centre of distribution in the eastern Mediterranean Region (Magnano & Alonso-Zarazaga, 2013; Białooki, 2015; Davidian & Gültekin, 2015). *Choilisanus*, with its type species *O. balcanicus* Stierlin, 1861, is – as many other subgenera of the exceptionally species-rich genus – a polyphyletic group within *Otiorhynchus* Germar, 1822. Just recently, Davidian & Gültekin (2015) resurrected the morphologically rather deviant *Stierlinellus* Reitter, 1913 from synonymy with *Choilisanus*, thus contributing to a rearrangement of this subgenus. Only four species of the subgenus are widely distributed, well outside the eastern Mediterranean: *O. balcanicus*, *O. brunneus* Gyllenhal, 1834 (by some authors also regarded as belonging to the subgenus *Arammichnus*, Gozis, 1882), *O. raucus* (Fabricius, 1777) (type species of *Asphaerorrhynchus* Reitter, 1912, actually synonym of *Choilisanus*), and *O. velutinus* Germar, 1824.

Recent investigations of the weevil fauna (Curculionoidea) of the two Aegean Islands, Samos (Germann *et al.*, 2015a) and Lesbos, allowed exciting new discoveries, especially in the broad nosed weevil subfamily Entiminae (Yunakov & Germann, 2008; 2012; Borovec & Germann, 2013; Germann *et al.*, 2015b). During a recent excursion to Lesbos Island by the second author together with Carlo Braunert (Luxembourg) from 25th April to 1st May, 21 localities were sampled. Around the two highest peaks on the Island, Oros Lepetymnos (968 m a.s.l.) in the

North, and Oros Olympus (967 m a.s.l.) near the centre of the island, an unknown member of *Choilisanus* was collected while sifting litter, described in the following.

MATERIAL AND METHODS

The type material examined is deposited in the following collections:

- cCB private collection Carlo Braunert, Mensdorf, Luxembourg
- cCG private collection Christoph Germann, Thun, Switzerland
- cPB private collection Piotr Białooki, Sopot, Poland
- MHNG Muséum d'histoire naturelle de Genève, Switzerland
- NMBE Natural History Museum, Bern, Switzerland
- SDEI Senckenberg Deutsches Entomologisches Institut, Müncheberg, Germany.

Methods:

A usual beetle sifter (grid diameter 7 mm) was used for collecting and the extraction method applied follows Germann (2014).

The pictures of the habitus and the genital structures were made with a 5-megapixel digital camera (Leica DFC425) under a stereomicroscope (Leica MZ16). The pictures are composites processed using the software Imagic Image Access (version 12) and then retouched using Adobe Photoshop version 10.0.1 (Adobe Systems Incorporated).

The measurements of lengths and widths (L/W) are mean values and were always taken at the longest and/or widest point. The size was taken without rostrum, from the fore margin of the eyes to the elytral apex.

Label texts are cited verbatim in quotation marks. Data from different labels are separated by a double slash (/). Additional remarks to label data are set in square brackets ([]).

Specimens (females) of *O. formaneki* Reitter, 1913 used here for comparison with the new species are labelled as follows: “26.06.2003 NW Turkey, Hatip env. [environment], SW Sinop, leg. P. Białooki” (cPB).

TAXONOMY

Otiiorhynchus (Choilisanus) theophrastus sp. nov.

Figs 1-7, 10-11

Holotype: NMBE (without accession number); ♂, dissected: “249_15.9 GREECE, Lesbos Isl., Oros Olympos, N39°04'14" // E26°21'15", 900 m, 28.4.2015, leg. C. Germann. Additional red label: “Holotype *Otiiorhynchus (Choilisanus) theophrastus* sp. nov. des. Białooki & Germann 2015”.

Paratypes: (all without accession numbers) MHNG, cCG, cPB; 2 ♂, 1 ♀; same data as holotype. – cCG; 1 ♂; “249_15.8 GREECE, Lesbos Isl., Oros Olympos, N39°04'20" // E26°21'11", 968 m, 28.4.2015, leg. C. Germann”. – cPB, NMBE; 1 ♂, 1 ♀; “249_15.10 GREECE, Lesbos Isl., Oros Olympos, N39°04'12" // E26°20'57", 802 m, 28.4.2015, sifting *Platanus* near spring, leg. C. Germann”. – cCG, NMBE; 2 ♂, 2 ♀; “249_15.13 GREECE, Lesbos Isl., Oros Lepetimnos, 7 km E Petra, above Pelloni, // near peak, N39°19'55" E26°15'28", 800 m, 29.4.2015, leg. C. Germann”. – cCB; 1 ♀; “28.4.[20]15 GR-Lesbos Isl. Oros Olympos Mt. 2 km W Agiásos rocky habitat summit // N39°04'20" E26°21'11" 970 m a.s.l. 2015-19 249-15-8 C Braunert leg”. – cCB; 5 ♂, 2 ♀; “28.4.[20]15 GR-Lesbos Isl. Oros Olympos Mt. 2 km W Agiásos macchie // N39°04'14" E26°21'15" 870 m a.s.l. 2015-20 249-15-9 C Braunert leg // sifting”. All with additional red labels: “Paratype *Otiiorhynchus (Choilisanus) theophrastus* sp. nov. des. Białooki & Germann 2015”.

Description

Male: body length 5.2-5.9 mm (holotype 5.3 mm); entirely dark-brown; covered with precisely recumbent (including elytral apical declivity) dark and light brown scales forming unclear maculation (Fig. 1).

Head very wide, forming with basal part of rostrum

joint cone rather strongly narrowed towards base of pterygia; entire dorsal half covered with small sparse punctures; eyes moderately large, 1.5× narrower than frons, impressed into head, moderately convex, but not projecting from head dorsal outline; frons fovea well developed, situated at frontal midlength, separating vertex/frons from anterior portion of frons dorsally fused with rostrum; hind dorsobasal portion of rostrum distinctly convex, thus well delimited from vertex/frons. Rostrum very short, 1.25× wider than long; pterygia large, strongly projecting outwards; scrobes closed anteriorly; dorsum strongly widened anteriorly; epistome subtriangular, hollowed, delimited by well-developed keels, anterior margin deeply excised; area between epistomal apex and frons fovea with well-developed median keel, better developed anteriorly.

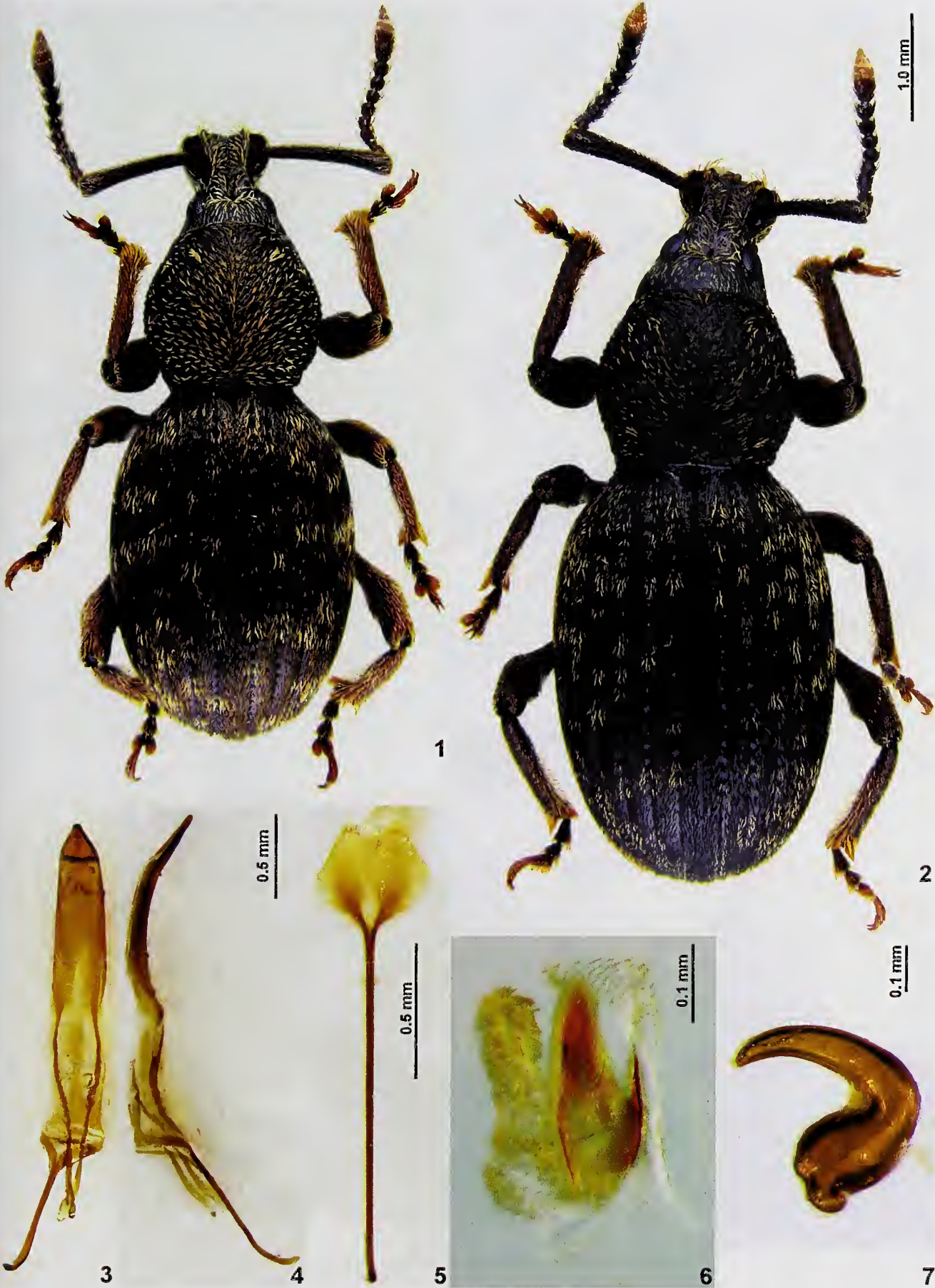
Antennae moderately robust; scape straight, weakly gradually widened apically, covered with dense, arcuate and weakly raised hair-like scales; first two funicular segments subequally long, slightly more than 2× longer than wide, weakly widened apically; third segment isodiametric; segments 4-7 moderately transverse; segments 3-7 with 1-2 combs of semi-erect light brown arcuate setae; club 2.5× longer than wide, as long as three funicular segments combined, rather weakly widened basally, apically narrowly pointed.

Prothorax slightly transverse, 1.1× wider than long, strongly rounded at sides, widest just behind middle, covered with small dense rather weakly convex tubercles; impunctate midline not developed; anterior margin distinctly shorter than base.

Elytra 1.4× longer than wide, 1.25× wider than prothorax, basally very weakly rounded, apical portion narrowly rounded; in lateral view very weakly convex, base slightly convex, apical declivity bent under; striae composed of big, moderately deep punctures; distance between striae punctures longer than their diameter; each puncture with single recumbent hair-like scale; punctures strongly gradually reduced posteriorly, making interstriae narrower than striae basally, and strikingly wider than striae apically; interstriae flat or hardly convex, covered with moderately dense microtubercles and/or rasp-punctures, shining; striae reduced posteriorly to very thin shallow sulci devoid of clear punctures; vestiture dense, largely obscuring integument.

Legs moderately short and rather thin; all femora unarmed, subequally thick; dorsal margin of fore tibia straight, only apical portion weakly curved inwards; ventral margin moderately bisinuate, with long yellow-brown long semi-erect setae; muero well developed; apical comb consisting of long yellow-brown dense setae; tarsi rather small, second segment somewhat

Figs 1-7. *Otiiorhynchus (Choilisanus) theophrastus* sp. nov. (1) Habitus of holotype (male). (2) Habitus of female. (3-7) Genital organs. (3). Aedeagus ventral view. (4) Aedeagus lateral view. (5) Spiculum ventrale. (6) Sclerites of the internal sac. (7) Spermatheca. ►





Figs 8-9. Habitus of *Otiorhynchus (Cholisanus) magnicollis* Stierlin, 1888 from Samos Island. (8) Male. (9) Female.

transverse, third segment much wider than second; onychium long, its projecting portion almost as long as preceding segment; middle and hind tarsi slightly longer than fore tarsi, in particular projecting part of onychium slightly longer than length of third segment.

Ventral side of body covered with similar recumbent vestiture as elytra; first ventrite broadly, shallowly impressed; anal ventrite 1.7× wider than long, strongly convex basally, towards apex gradually flattened.

Aedeagus rather weakly gradually tapered apically, apical portion abruptly narrowed forming thin rounded apex, in lateral view weakly uniformly arched; apodemes

about as long as median lobe (Figs 3-4). Projecting portion of internal sac with two unequal sclerites: a big one, feathered and elongated-pointed, and a small one, thorn-shaped (Fig. 6).

Females: (Fig. 2) body length 5.5-7.5 mm; elytra longer, 1.55× longer than wide, wider in comparison with prothorax (1.35×), less convex longitudinally; tibiae slightly more robust; first ventrite not impressed; spiculum ventrale long and slender, plate rhomboidal with apical margin moderately deeply excised (Fig. 5); spermatheca C-shaped, with very short ramus and strongly bowed and short nodulus (Fig. 7).



10



11

Figs 10-11. Habitat aspects of *Otiorhynchus* (*Choilisanus*) *theophrastus* sp. nov. on Lesbos Island. (10) Oros Olympos, type locality. (11) Oros Lepetymnos.

Distribution: *O. theophrastus* is known so far exclusively from Lesbos Island, and probably endemic there.

Bionomy: The new species was found in April-May by the second author and Carlo Braunert from sifted leaf litter under *Quercus coccifera*, *Platanus*, cushion plants and mosses above 800 m a.s.l. in the area of the two highest peaks on the island (Figs 10-11).

Etymology: Named after the student and successor of Aristoteles, Theophrastus (371-287 BC), philosopher and naturalist native to Eresos on Lesbos Island.

Type locality: Greece, Lesbos Island, Oros Olympos, 39.07056°N 26.35417°E, 900 m.

Diagnosis: *Otiorhynchus* (*Choilisanus*) *theophrastus* sp. nov. is close to *O. (Choilisanus) magnicollis* Stierlin, 1888. *Otiorhynchus magnicollis* was originally described from specimens from Iearia (= Nikaria) (Stierlin, 1888), and was compared with *O. grandicollis* Boheman, 1842, which shows a certain similarity regarding the prothorax, although more rounded in the latter species. Much more widespread than *O. magnicollis*, *O. grandicollis* is reported from Bulgaria, Turkey up to Iran (Magnano & Alonso-Zarazaga, 2013). However, conspecificity of specimens from Turkey (Nif Dağı, Kemalpaşa; Keskin & Çevik, 2008) should be critically reinvestigated. Thanks to the comparison of specimens of *O. magnicollis* from Samos (used here for comparison with *O. theophrastus* sp. nov.) with the type in the collection of Gustav Stierlin, conserved in the SDEI, the conspecificity could be confirmed by the first author, hence the identifications in Germann *et al.* (2015a) are now confirmed.

O. theophrastus sp. nov. differs from *O. magnicollis* in: rostrum dorsum narrower, distinctly widened anteriad; pterygia larger, stronger projecting outwards, 1.6× broader than rostrum minimum width; head dorsum entirely covered with small sparse punctures; strikingly thinner antennae, third funicular segment almost isodiametric, remaining segments weakly transverse; antennal club much more elongate, gently widened basally; pronotum covered with very small dense, weakly convex tubercles; elytra more narrowly rounded at humeri; pronotal and elytral vestiture precisely recumbent; legs slim (Figs 1-2).

The rostrum dorsum of *O. magnicollis* is wider, subparallel sided; pterygia small, less projecting, 1.4× broader than rostrum minimum width; head dorsum covered with coarse longitudinal wrinkles; antennae very robust, funicular segments 3-7 strongly transverse; club short, very broadly rounded basally; pronotal tubercles strikingly bigger, strongly convex; elytra broadly rounded at humeri; pronotal and elytral vestiture clearly raised; legs robust (Figs 8-9).

Another similar species, *O. formaneki* Reitter, 1913 differs mainly from *theophrastus* sp. nov. in the shorter

elytra (1.3× longer than wide in female) more strongly rounded basally and slightly wider in comparison with prothorax (1.4×); the elytral vestiture recumbent with rows of semi-erect setae; the pterygia smaller, less projecting and 1.4× wider than rostrum minimum width; rostrum dorsum weakly widened anteriad; antennae and legs.

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|--|---------|
| de Chambrier A. & Scholz T. - An emendation of the generic diagnosis of the monotypic <i>Glanitaenia</i> (Cestoda: Proteocephalidae), with notes on the geographical distribution of <i>G. osculata</i> , a parasite of invasive wels catfish | 1-9 |
| Bassi G. - Studies on Afrotropical Crambinae (Lepidoptera, Pyraloidea, Crambidae): Notes on the genus <i>Aurotalis</i> Bleszyński, 1970 | 11-20 |
| Hollier J. - The type specimens of Orthoptera (Insecta) species described by Ignacio Bolívar and deposited in the Muséum d'histoire naturelle de Genève | 21-33 |
| Pham V.A., Le T.D., Pham T.C., Nguyen L.H.S., Ziegler T. & Nguyen Q.T. - Two additional records of megophryid frogs, <i>Leptobrachium masatakasotoi</i> Matsui, 2013 and <i>Leptolalax minimus</i> (Taylor, 1962), for the herpetofauna of Vietnam | 35-43 |
| Eguchi K., Bui T.V., Oguri E. & Yamane S. - The first discovery of the " <i>Pheidole quadricuspis</i> group" in the Indo-Chinese Peninsula (Insecta: Hymenoptera: Formicidae: Myrmicinae) | 45-55 |
| Breure A.S.H. - Annotated type catalogue of the Orthalicoidea (Mollusca, Gastropoda, Stylommatophora) in the Muséum d'histoire naturelle, Geneva | 57-103 |
| Lienhard C. & García Aldrete A.N. - An extraordinary new species of <i>Psyllipsocus</i> (Psocodea: 'Psocoptera': Psyllipsocidae) from the Biosphere Reserve Sierra de Huautla, Morelos, Mexico ... | 105-112 |
| Breure A.S.H. & Tardy E. - From the shadows of the past: Moricand senior and junior, two 19th century naturalists from Geneva, with their newly described taxa and molluscan types | 113-138 |
| Anisyutkin L.N. - New and little known Epilamprinae (Dictyoptera: Blaberidae) from the collections of the Muséum d'histoire naturelle de Genève and the Zoological Institute RAS, Saint Petersburg. Part 2 | 139-152 |
| Yin Z.-W. & Cuccodoro G. - <i>Colilodion schulzi</i> sp. n. (Coleoptera: Staphylinidae: Pselaphinae) from Palawan, the Philippines, with habitus photographs and a revised key to all <i>Colilodion</i> species | 153-158 |
| Löbl I. & Ogawa R. - Contribution to the knowledge of Himalayan and North Indian species of <i>Scaphidium</i> (Coleoptera, Staphylinidae) | 159-163 |
| Schuchert P., Sanamyan N. & Sanamyan K. - Observations on two large athecate hydroids (Cnidaria: Hydrozoa) from the Kamchatka Peninsula (NW Pacific) | 165-178 |
| Benjamin S.P. - Revision of <i>Cebrenninus</i> Simon, 1887 with description of one new genus and six new species (Araneae: Thomisidae) | 179-200 |
| Białooki P. & Germann C. - <i>Otiorthynchus (Cholisanus) theophrastus</i> sp. nov. from Lesbos Island, Greece (Coleoptera, Curculionidae, Entiminae) | 201-207 |

Indexed in Current Contents. Science Citation Index